1983 FAA R. & D. AUTHORIZATION

HEARINGS

BEFORE THE

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AVIATION AND MATERIALS

OF THE

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SCIENCE AND TECHNOLOGY
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[1] On assignment to Budget Committee for 97th Congress.

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1983 FAA R. & D. AUTHORIZATION

TUESDAY, FEBRUARY 23, 1982

House of Representatives,
Committee on Science and Technology,
Subcommittee on Transportation,
Aviation and Materials,
Washington, D.C.

The subcommittee met, pursuant to notice, at 10:07 a.m., in room 2318, Rayburn House Office Building, Hon. Dan Glickman (chairman of the subcommittee) presiding.

Mr. Glickman. The subcommittee will be in order.

Why don't we go ahead and start? Other members will be here, I have been informed, as the morning wears on. There are about 228 committee hearings this morning—I am not exaggerating—and so we will get started so that the Administrator can present his statement, and by that time other members will be here so we can ask some questions.

I am pleased to welcome Lynn Helms, the Administrator, today, who, just as a side note, I think has done a splendid job as Administrator of this agency during difficult times, both budgetary and otherwise, and who has come to us today not only to talk about, perhaps through questions, general operating plans of the FAA—and we will get into those more deeply when we talk with Mr. Albrecht tomorrow afternoon, too, I think—but particularly to talk about the most novel and complete and dynamic change in the operation of this Nation's airways that we have ever seen.

For many years, this subcommittee has had a unique view of FAA activities. Our jurisdiction over research and development has given us an unusual opportunity to observe the entire systems acquisition and operation process. As a result, we have seen very clearly that there was a need for better long-range planning. This was particularly true in the case of coordination between R. & D. and capital equipment acquisitions.

I might admit that part of the problem was the repeated change in administration. Changing administrators had different ideas on how to pursue what R. & D. that they had done and how to implement it into capital equipment. We impugn nobody's motives in that process, but in some areas nothing was done.

So when the FAA began talking about modernizing its en route computer system, the subcommittee took specific legislative action to encourage better planning. We were concerned because the so-called 9020 replacement would be the largest nondefense computer buy ever made by this Government. As such, we felt it warranted special consideration.

The result was House Resolution 202, which expressed the sense of Congress that full planning documentation should be prepared and submitted. Furthermore, we expect these plans to be fully consistent with the administration's overall proposals for both taxes and expenditures from the Airport and Airway Trust Fund.

Today, the subcommittee will receive the first congressional testimony on the FAA's response to House Resolution 202, the national airspace system plan, although that document has in fact been available for at least a month publicly and has received a great deal of discussion and comment by members of the industry.

This document goes well beyond the original requirement for a computer replacement plan. In fact, it lays out a blueprint for modernization of the entire air traffic control system.

On first reading, from my own perspective, it appears to be a very comprehensive, well thought out 20-year plan of action. There is no doubt that Administrator Helms has taken that first big step toward better planning. For that I want to heartily congratulate him.

As for the specific details of his plan, I would not want to form any premature conclusions. It is a massive undertaking, and I feel that we must hear from all those who will be affected.

Today, we begin with the Administrator, and later in April we will invite others to present their views. I know that the Administrator is going to give us, I believe, some discussion of the nature of the plan. To the extent that he is able to do so today, we will talk generally about funding issues. Perhaps you might also want to respond, to the extent you can, on responses that you have received from the users of the air system.

I must tell you, from my own perspective, Sunday morning's Wichita Eagle showed that the layoffs are beginning to intensify in the industry, and I think that, to some extent, how you can relate the operation of this plan and funding requirements to what might otherwise be a depressed industry might also be useful to us.

I am pleased to welcome my colleague from Ohio, from Columbus, Bob Shamansky. Do you have any comments before we begin?

Mr. SHAMANSKY. My comments, Mr. Chairman, are that it would be difficult to improve upon your opening statement.

Mr. GLICKMAN. Even though you represent the area of Ohio State University and I went to the University of Michigan, I will still thank you for those comments. [Laughter.]

And now, Mr. Helms, why don't you begin?

STATEMENT OF HON. J. LYNN HELMS, FEDERAL AVIATION ADMINISTRATOR, ACCOMPANIED BY AL ALBRECHT, ASSOCIATE ADMINISTRATOR FOR ENGINEERING AND DEVELOPMENT, AND VALERIO R. HUNT, DIRECTOR, ADVANCED AUTOMATION PROGRAM OFFICE

Mr. HELMS. Thank you very much, Mr. Chairman and members of the subcommittee.

It is a pleasure to appear before you today to open the congressional discussion on the National Airspace System Plan. Accompanying me are Mr. Al Albrecht, on my right, the Associate Administrator for Engineering and Development, and Mr. Val Hunt, on my left, the Director of the FAA's Advanced Automation Program Office.

The plan I am going to briefly describe is the culmination of 10 months of intensive study by the FAA, and using inputs from both industry, academic, and consultant groups. I personally directed this review and was deeply involved in all facets of it. I believe that the implementation of the plan which grew out of it will ensure a safe and efficient national airspace system through the end of the century.

One item I would like to mention in advance. While the plan itself is of vital interest to both the Congress and the public, nearly of equal importance to the Congress is the method used to establish the plan. That method was selected to be specifically responsive to numerous congressional directives, inquiries, hearings, and recommendations. That extensive review established two things with certainty: first, the slack in time has been used up. We as a nation must now make a decision. We start the modernization now or we suffer the consequences, starting initially not later than 1986. Two, the most critical problem for the future will be availability of runways. Airport capacity is rapidly being outstripped.

I would now like to point out some of the highlights of the plan. Would you please start the slides.

[Slide 1 shown.]

The official title of the plan is the National Airspace System Plan. Actually, it is more than a plan. It is a 450-page decision document spelling out in detail how the national airspace system will evolve over the next two decades.

It lists and describes specific improvements in facilities and equipment at both the subsystem and component level that are needed to meet projected demands for aviation services between now and the year 2000.

It responds to the need of all elements in the aviation community but on a system basis. I will elaborate on this in greater detail later.

The plan describes how system modernization will save users and taxpayers approximately $25 billion in reduced operating costs through the year 2000. This will be accomplished by higher levels of automation, consolidation of major facilities, rapidly changing and lower cost technology in telecommunications.

[Slide 2 shown.]

It stresses that these improvements must be made to conform with these guiding principles now directing the FAA. Internally, I have had a message to our FAA personnel, and that is, it is not "our" airspace; it is theirs, the taxpayers. We are paid merely to help them use it safely, and I emphasize safely. The FAA owns no airspace.

Basically, the FAA should control but not attempt to constrain the flying public. Second, we should regulate but not interfere with free enterprise or competitive purpose. Third, we should recognize that most air travelers do so by means of the scheduled air carriers, and as such we have a responsibility to consider that larger segment's priority, but never to the extent that it excludes the single individual from enjoying man's greatest achievement—solo flight. We must ensure that the private flier has access to the system.

[Slide 3 shown.]

This briefly shows how we got where we are today. Today's air traffic control and air navigation system is the safest in the world. But it is a combination of equipment, procedures, and skills that have evolved over 40 years. In fact, it stands as a monument to man's creativity and dedication to purpose.

It has produced a mixture of equipment of many ages, technologies, and types. However, this system is labor-intensive. It is expensive to operate and maintain. It has little capability to accommodate future growth. Most importantly of all, perhaps, it has no capability to accommodate future automation needs which are mandatory for efficiency in our operations throughout.

[Slide 4 shown.]

This gives you a feeling about FAA's system today and how it is distributed. What the numbers do not show, however, is that today's system is characterized by: vacuum tube type electronic equipment and its associated high operations and maintenance costs; different types of computers and software in each air traffic control or ATC subsystem; different types of controller consoles and display equipment in en route and terminal facilities, multilayered, overlapping coverages of navigation aids, communications sites, and surveillance facilities; a large number of individual ATC facilities with the accompanying overhead costs; the largest Federal communications system that exists outside of DOD; and extensive and expensive supply, training, and technical support facilities. The more part numbers, the more the logistic train that must support it.

[Slide 5 shown.]

These are the items which drove the plan and summarize what we are trying to accomplish. In short, the plan addresses how best to: accommodate spiraling demands for aviation services; constrain costs; establish the required technical framework and plan for transition to the new system; and deal with aging facilities.

We cannot meet future demand by just extending the ATC system using "more of the same" techniques. We must restructure the facilities and equipment as well as some procedures to accommodate the demand.

[Slide 6, 7 shown.]

When I talk about demand, I should identify some brief samples of these. The easiest way to read this chart is starting on the bottom from left to right, in which we show 1981, 1985, 1990, and 1993. This shows, for example, the growth in flight services projected. I wish to emphasize that all of this data that represent the demand, while submitted by the FAA and while coordinated by the FAA, were not generated by the FAA. It is the result of an annual planning conference which takes data from many institutions and organizations.

It clearly shows the demand on the system will continue to grow. It is plainly evident that all users intend to fly more, especially commuters. Note the increase in commuter operations to 235 percent of the 1981 level. It also is evident that use of helicopters will grow at a high rate, far higher than the average of the remainder of aviation, a point which must be considered in the development of this plan and in fact was considered.

The numbers might change in future forecasts, but the trend is obvious. As I said, while these data are published by FAA, they come from all segments of the industry.

[Slide 8 shown.]

Other sections which we have to appoint ourselves to make sure that we are responding include one consideration that stands out above all the rest. It is unlikely that we will have another Dallas-Fort Worth airport. Of all the things that will limit the future growth of aviation, it will be concrete or asphalt—the lack of runway capability.

We need to achieve maximum use of what we have through improved system capacity. This can be helped through flow control, getting in and out of the airport area. I wish to emphasize that is not a continuation of the flow control necessitated by the controller situation but rather the kind of flow control we have had for 50 years, and that is the control of traffic around the terminal and coming into the runways and departing the runways.

Simply put, if we can reduce the time on the concrete from 55 seconds to 40 seconds, look at the increase in capacity of airports. FAA has a number of computer and other study programs underway to see how automation can improve airport capacity. It is this additional R&D which will be done on a continuing basis to support the National Airspace System Plan.

But it is certain that airside congestion is going to get worse, since concrete will continue to be the primary limitation. We absolutely must keep airports open, or the nation's economic development will be constrained.

Let me put this in a philosophical but historical precedent. Man first used the horse to ride and then found he could combine it with a wheel and haul ten times as much. He first derived the railroad to haul people, and today it is primarily freight. He first came up with boats to carry people, but today oceanliners are predominantly freight.

The auto was first derived to carry people, but today most of the nation's freight is carried by trucks on the nation's highways. The airplane is still being used for people, but the fastest-gorwing segment is freight. Airport construction will limit this nation's ability to have economic growth unless we move forward with it.

[Slide 9 shown.]

Here you see the airside congestion that is starting to develop. In 1981, eight air carriers and three reliever airports are about to reach saturation. The projections show that by 1990 there will be 41, and by the year 2000 there will be 91.

[Slide 10 shown.]

For the past 11 months, then, the FAA has been approaching this total problem in the review resulting in the National Airspace System Plan, analyzing all technical programs, balancing them against budgetary, regulation and airspace policies, and integrating them into a total system plan.

I initiated this review and participated fully in the hundreds of briefings and hours of discussion necessitated to ensure a comprehensive system view.

In talking to long-time FAA employees and the private sector, it is commonly agreed among them that this is the most comprehensive review internally within the FAA since the move to automation in the early sixties.

The approach I used was, starting in February, to derive system alternatives, as shown across the top, and from this, in an iterative fashion, develop a system plan recognizing historical budget policies which are required by the Congress, regulation policies which must ensure that safety is maintained within the air system, and airspace policies; that is, how we use that airspace system.

[Slide 11 shown.]

From this, then, the review has resulted primarily in twofold elements. First is the National Airspace System Plan, which I will describe in greater detail. This specifically deals with facilities and equipment and supporting research and development. It is oriented to equipment and facilities.

Paralleling this, and just underway, is the National Airspace Review, which involves a study of the operational uses of the nation's airspace, including air traffic control procedures, flight regulations, and the airspace environment.

There will be an additional two plans. One of these will be an R&D plan which lays out in detail how we will implement this. A fourth one will be the system support plan, how we will support this by logistics, space parts, provisioning, training, manuals, and documentation in later years.

All of these elements, then, will be folded into our overall management plan, which will not be formalized to the extent of a printed document. But these two go hand in hand.

[Slide 12 shown.]

The goal has been to combine the equipment and facility improvements in the National Airspace System Plan with the procedural and policy improvements in the National Airspace Review, blend them into a single planning process resulting in an integrated system selectively tailored to unique individual requirements.

The goal is to combine required equipment and facility improvements with procedural and airspace improvements which will be coming out of the then-ongoing National Airspace Review. The intent is to have the facilities and equipment base flexible enough to achieve an integrated system selectively tailored to unique requirements.

The major portion of the effort under the National Airspace Review will be carried on by users, people outside the FAA, to ensure that their voice is adequately heard and we take adequate advantage of their experience. Our review of these two approaches shows that this can be done, that the two plans will blend together.

[Slide 13 shown.]

While this chart appears to be very busy, and in fact, Mr. Chairman, it cannot be read, I present it to show the process through which we went in developing the National Airspace System Plan.

We began with past policies, budgets, technology levels, and environment for a given time period, and from this we established that all systems and subsystems within the FAA could be contained within one of six subsystems: en route, terminal, flight service, ground-to-air, interfacility communication, and auxiliary systems.

Reiterative processes, then, established a current system configuration, and these were bounced, then, against three items with which the FAA must come in constant contact but which we do not specifically control; that is, the airborne equipment, the policies and procedures that may in fact be adopted, and airspace regulations which impinge on international activities, also.

As each element was defined, then, we ran it by each of these three and took it to the next iteration to further redefine the subsystems in each of those categories.

[Slide 14 shown.]

The identifications are the same as I outlined before. Coming out of that, then, on the botton right-hand side of the chart, is where we took every subsystem and then bounced it against what we thought advanced technology could do.

My primary concern was, because of the impact of transition—remember, the FAA must be 100 percent reliable—and because of my concern that we could not take the risk of further delay, I made the decision that the FAA would not go into exploratory development; that is, the systems which we defined would not engage in technological risk but would ride the peak of the curve of known technology.

For example, in this area, I considered satellites for the entire air traffic control system. I used three separate outside inputs, one from DOD, one from the University of Princeton, and a separate group. All three concluded the same as my own analysis: A, the satellite system is not within this time frame. The infrastructure to get such a system in being by 1990 does not exist. However, certain aspects of a satellite system such as navigation and possibly communications could come about in the latter part of this decade.

Another example was using cockpit displays for tactical control of aircraft. I visited NASA/Langley, reviewed the simulator program, reviewed the installation in the 737 in some depth to see, is it possible to transfer authority from complete control on the ground to partial control in the air. This clearly established that it is not possible to do so. To separate control among two different activities or two different individuals without far, far greater research and a delineation of responsibilities could not be accommodated.

Each of the ongoing technologies, then, was bounced out of this, and final subsystem decisions and system definitions came out of the top for the varying time periods as shown.

[Slide 15 shown.]

Now, these are typical of the areas and systems which we reviewed during this year of formulation of the National Airspace System Plan. Computer modernization and improved weather are two subjects that seem to be of special interest to the aviation community, and I will briefly highlight them shortly. In fact, some of these, however, after extensive technical evaluation and appraisal, did not survive the evaluation. In fact, some of the items on this list did not survive. But these were the systems which we reviewed during this evaluation time period.

As an example, neither TIDS Terminal Information and Display System nor Electronic Tabular Displays survived in their entirety.

[Slide 16 shown.]

The policy emphasis underlying the plan dictates where we go from here. It identifies segments of the aviation community we have not completely addressed ourselves to in the past—i.e., particularly, rotary wing operations—and prescribes what we are going to do.

It was clearly established that we had to take a total-system approach, flexible enough to accommodate future demands in technology but without the nowaday commitment to the cost and to the expansion requirements. Rather, we have the technology and the base for that expansion.

Most important was to improve vital safety services: collision avoidance, weather, and landing systems. You will note again additional emphasis on weather as one of the two major items of fatalities and accidents in aviation.

The system evolution, then, integrated an air traffic control system based on commonality of system components, operational flexibility, and expandability.

[Slide 17 shown.]

These are self-descriptive, but perhaps the last one, the TCAS, warrants additional discussion. The first tangible result of the technical review was the selection of the Traffic Alert and Collision Avoidance System, TCAS, as an independent airborne backup to the ATC system. This was not a capricious decision. Rather, it started to unravel the extreme complexity and cost of a 100 percent ground-based system.

TCAS actually is two separate but compatible systems, TCAS I being a low-cost, minimum capability version designed for general aviation that will run about $2,500. The review clearly established that without a collision avoidance program for general aviation, we did not have a collision avoidance program. Essentially, in its most minimal form, it is a proximity warning device that alerts pilots to the presence of other aircraft. However, at the pilot's option, he can add other elements to it to make it more informative.

TCAS II, the full collision avoidance system, detects potential traffic conflicts and provides pilots with evasive maneuvers when necessary. We expect that the airlines and the larger class business aircraft will be the primary users.

The TCAS decision had a major impact on policy and was an important building block in the total program. Most importantly, it had to operate independent of the ground so that is could be used in any portion of the U.S., under any condition, without a requirement of ground control.

[Slide 18 shown.]

As stated earlier, during our reviews we found that, basically, there are six general subsystems in the National Airspace System Plan. In the book which we will furnish copies of to the committee and the staff, you will find the chapters as identified over on the right, the first one being the overview; the second one being expansion of the demand on the system, which I briefly summarized; and the remaining six, specific chapters identifying subsystem elements.

[Slide 19 shown.]

For example, chapters III and IV cover en route and terminal systems. This makes the system a little more clear in that it shows the combination of 209 operation centers to about 60 common modular computers and software. These satisfy a wide range of needs and reduce procurement costs. Automation; the use of automation aids to achieve enhanced safety, capacity, and productivity.

[Slide 20 shown.]

As part of our analyses, we looked at the type of data required and functions performed in en route systems, terminal systems, and tower systems. We found that the data required and functions performed are basically the same in all cases, leading to the generic representation shown by this slide.

First, a large central processor is required for centralized functions, handling large data bases and communications with other processors we interface to. But we also need processing capability as close to the user as possible, distributed to minimize the effect of interruption or failure.

This led to the sector suite idea, a sector suite is our definition of what a controller sits in front of when he is looking at a scope, with additional panels to his left and right.

[Slide 21 shown.]

The generic approach allows us to use the same basic systems for en route and towers and allows us economies in development and procurement, minimizing training requirements, economies in maintenance, training and logistics.

[Slide 22 shown.]

From this then, it became evident that we should back off and recognize that it is the sector suite which will make the largest segment of cost, not the computer. The computer will be used in the key centers, but the sector suite will go throughout the ATC system. To the degree that we can automate this, we get our greatest productivity increase and our greatest reduction in need for additional trained manpower.

[Slide 23 shown.]

Once having identified the various options that were available to us, it became evident that with full automation, what was formerly done by three controllers could now in fact be done by one controller.

Additional studies have been conducted, and in fact we have had over 40 of our controllers participating in the evaluation at our Atlantic City Research Center and at one of our subcontractors.

[Slide 24 shown.]

From this, it became evident, then, that there were two groups of requirements that had to be satisfied. The first group we refer to as numbers 1 through 7, or near term. This is the group of requirements that exist specifically to carry on the ongoing business. You will note, for example, that this chart clearly reflects the state of our evaluation in July, and you note on item 5 it still referred to a DABS interface. DABS has since been dropped, but as a result of this, it allowed us to identify the separate segments with which we had to achieve some type of compatibility.

[Slide 25 shown.]

Items 8 through 11 are the next generation, the automated ones, to give us the additional benefits; specifically, fuel-efficient route planning and flow planning and traffic management and strategic clearance planning, with the full tactical clearance generation and execution carried on for the terminal facilities.

[Slide 26 shown.]

Chapter V discusses the flight service system. FAA programs to consolidate its more than 300 flight service stations into a network of 61 automated facilities are already underway. It was originally presented to the Congress in 1980, defined again in greater detail in 1981, and now is ready for implementation. The initial three or four sites have already been established, and throughout the coming year, additional ones will be selected.

New equipment will provide flight service station specialists with rapid retrieval of information they need to brief pilots on weather and other flight conditions. Eventually, the new system will also be able to give pilots direct access to the computer data base from a remote computer terminal at airports and other accessible locations.

Tied in very closely with the flight service station modernization program is a major upgrading of weather services that are provided directly to the pilots.

[Slide 27 shown.]

This plan calls for installation of automated weather sensors to broadcast surface conditions by means of a computer-generated voice over VOR radio navigation stations, thus enhancing safety and allowing lower weather minimums for landing.

It presents the pilot with the opportunity for getting what I refer to as "nowcasting." It will be updated once each minute, and if there are five airfields, within a 5-minute period, all five airfields, with their automated weather observation systems, will be reported at the closest VOR. This will be the largest single step to benefit the general aviation pilot to ensure he can have weather at any VOR.

The addition of Data Link to the ATC system will also allow the pilot to obtain current weather information along his route, at his destination, as well as forecasted delay information. He can even file or modify his flight plan through this system. But I wish to emphasize that now that Data Link is optional this is an additional weather feature which we are making available.

[Slide 28 shown.]

This is a block diagram that is ordinarily presented with five overlays, Mr. Chairman. It shows, on the right, the existing airflight service stations and the entire flow showing out of the top, a Data Link providing on-demand weather to those aircraft that decide to install it and which, by keying in a weather request code and the location, again that pilot will have a printout and be able to get "nowcasting" weather from his forward destination points.

It is tied in across the top with weather radar from either the nation's weather service or DOD. Finally, over on the left, it shows again sector suites showing that now the controllers and the people at the terminals controlling traffic will have updated weather. This system is an integral part of the system and cannot be delayed. We must move forward with improved weather.

[Slide 29 shown.]

Chapter VI refers to the ground to air system. We plan to begin purchasing the new microwave landing system, or MLS, in 1983 and have 1,250 of them in place by 1998. MLS provides precision guidance over a much broader area than the present ILS, and that will greatly enhance operational flexibility at airports.

For operators, this will translate into fuel and money savings that will more than compensate for the capital investment of compatible avionics. The transition is long so that most operators will be able to make the change in the normal course of events. Admittedly, MLS will require an additional piece of avionics equipment, unless the industry provides dual selection. I expect that the creativity of industry will in fact do this.

The TCAS decision described earlier, allowed us to drop the development of a very expensive ground-based collision avoidance system. This in turn simplified the requirements and greatly reduced the cost of implementing a new secondary radar surveillance system called Mode S.

Mode S is a high capability system. "S" stands for selective address, which means ground stations interrogate aircraft on an individual basis, rather than on the present "all call" system. I emphasize again, however, it is optional, not planned to be mandatory.

The former DABS system is thus replaced with a much more simple and a much more cost-effective system.

[Slide 30 shown.]

Communication costs give FAA one of the largest bills it has to pay. In 1980, our communications cost was $80 million. Our projection for 1982 was initially $140 million. By going out competitively for satellite channels and other means, we expect to reduce that cost and in fact did reflect the reduction in our supplemental request.

But by 1990 communications costs could, if not replaced with lower-cost telecommunications, hit $.5 billion, and if we projected the rate of growth from 1976 through 1982 with no changes, in the year 2000, FAA's communications cost would be $1 billion.

A major recommendation in the plan involves the establishment of a national airspace data interchange network, NADIN. It will evolve into a general-purpose, data transmission system with alternative routing capabilities to bypass failed or saturated areas. The system will be designed so it can transmit using whatever medium proves to be the most cost effective at the time it evolves. It is also being designed to take on the additional communications responsibilities of the rest of the Department of Transportation.

[Slide 31 shown.]

Auxiliary systems are covered in chapter VIII, and this refers to equipment and processes required to support the national airspace system. It includes buildings and plants, maintenance and support, flight inspection.

A very key item is remote maintenance monitoring of communications and navigation sites. This will permit us to cut the number of manned facilities by two-thirds. We have already brought some of these onstream and, in the chairman's area in Kansas, we have been testing these now for some months. The remote maintenance monitoring concept is extremely effective and has thus far been 100 percent reliable.

Maintenance savings are anticipated from the replacement of vacuum tube type electronics equipment with solid-state devices. This program is well underway with FAA contracts to replace more than 900 radio navigation aids, or VORTACS.

Our program for flight inspection of navigational aids will be streamlined with the addition of new, more fuel-efficient aircraft and the adoption of automated techniques that will cut the number of flight hours by more than 60 percent by the year 2000, saving at least 5 million gallons of fuel each year.

Fleet conversion to turboprop aircraft, in fuel savings alone, hits a payback crossover point in just 4 years.

[Slide 32 shown.]

The plan, in summary, provides for significant service improvements and cost reduction in nearly every aspect of the national airspace system. The major results of implementing this plan are as follows:

System errors will be reduced. Surveillance and weather data will be processed and disseminated expeditiously, much wider, and automation aids will complement operator activity wherever appropriate.

Growing demand will be accommodated in a way which permits airspace users to achieve their desired flight operations with a minimum of artificial constraints and with the highest practical fuel efficiency.

When required, a flow management process will operate to assure equitable delay distribution and advanced information to permit planned accommodations to flow restrictions and capacity limitations. I emphasize, when required.

Major increases in productivity—that is, air traffic control and systems maintenance—will result from the upgrading and replacement of obsolescent systems and the introduction of new techniques.

Facilities will be consolidated to achieve reduced overhead costs and to group compatible services. Standardized computers, displays, communications and navigation system elements will be used wherever practical to achieve efficient and economic operation.

An efficient, flexible computer data processing and control system will be implemented which will permit the introduction of increasingly higher levels of ATC automation.

[Slide 33 shown.]

To summarize, here are the key major decisions which will serve as the keystones of the system plan:

We do not wish to place new mandatory equipment items on all owners. People who have grown up in aviation and seldom use the national airway system should continue to have the freedom to fly in their areas as long as they do not impact the safety and efficiency of other operators.

The growing demand for service will probably require that those who intend to fully use the system—that is, penetrate TCA's or file a flight plan en route, using an IFR flight plan—will probably have to have some form of minimum black box which includes an encoding altimeter and transponder. The projected growth in aviation makes the air population too dense to continue indefinitely. This is not a firm decision, but all our data indicate that this will probably be required by 1991.

[Slide 34 shown.]

Additional items that are key points are that the FAA will proceed in upgrading many of the subsystems now being used. The highest practical level of ATC automation with an integrated flow management process will be implemented.

[Slide 35 shown.]

Most important, TCAS will be an independent system, completely independent of the ground. Mode S, with the Data Link, will replace the ATC radar beacon system.

En route primary radar will be phased out by the year 2000. Terminal primary radar with a weather channel will be continued.

A new weather radar system will be provided to complement the terminal radar weather channel, probably NEXRAD. Again, I note the emphasis on improvement in weather information to pilots.

An automatic traffic advisory service may be developed for a limited terminal application. Specifically, projections show that the aircraft population in the Los Angeles Basin alone in the United States could conceivably require some additional service. To develop a national system for that one need is not cost-effective.

[Slide 36 shown.]

As a result of the planned actions, users will be the primary beneficiaries of these improvements. Although no additional equipment will be required for most of these new services, there will be some. The following equipment is anticipated to permit full participation in the system:

Mode S Data Link, which is not mandatory but will be available to all users. ILS will be supplemented with, and subsequently replaced by, MLS. International treaties require that we keep ILS at international airports through 1995.

A 720-channel capability of communications and TCAS will be made available.

The user implications for benefits are as shown on this slide. Mostly, I have to acknowledge that the user will have to pay for it, Mr. Chairman.

The FAA's National Airspace System Plan, then, is a true system approach. It allows the ATC rebuilding to continue. It provides significant benefits to the public, the user, and the Federal Government. It is a timely approach without significant regulatory impact.

The plan will permit the evolution of the system from segregated—en route, terminal, et cetera—to an integrated system. It will ensure no degradation or loss of existing services.

It will improve services where deficiencies exist, accommodate future traffic levels and future demands for services, and it reduces future staffing levels and operations and maintenance costs, not giving any single segment what that segment would like to have and pay for, but it will serve the needs of all. It will meet the needs of all and increase the needs of the air traveling public.

Finally, Mr. Chairman, on this subject, while I am personally confident of the decisions made as regards this system plan, equally I am mindful of the very large expenditures that the aviation public will be asked to support, and I believe it fundamental that we take such steps as are necesssary to provide an early review of the FAA Systems Plan.

Accordingly, we have asked the Scientific Advisor to the President, Dr. Keyworth, to establish a panel to review the plan and confirm its integrity or identify any areas of doubt with recommended approach.

Copies of that panel's report will be immediately furnished to this and other committees on receipt. We hope to have the panel study completed before May 31. I will keep the chairman advised of these results.

Pursuant to the committee's interest, then, one final subject I would like to address is program and FAA management. Over the past months, as I have reviewed the FAA programs, I also evaluated the process and procedures that were used to manage these programs. Major changes in how the FAA will manage these acquisition programs are necessary, and I have taken steps to implement those changes.

Two months ago, I published internally a plan for implementing new procedures for systems acquisition management. Major highlights of this plan include: one, identify major system acquisitions and focus top management attention on these key programs. I as Administrator will approve the initiation of any major program based on validated requirements.

Two, refocus and reconstitute the FAA's Aviation System Acquisition Review Committee, or ASARC. I will chair this committee, and the associate administrators will be active members. Attention will be focused on a review of those programs at critical decision points. Newly designated programs may enter the key decision process at different points depending upon their state of development and when they are designated.

Three, establish an independent audit function within the FAA under a separate associate administrator to evaluate program performance, schedule and cost, and identify problems to the program manager, the ASARC, and myself.

Four, appoint a program manager for each major system acquisition. The program managers are to be provided appropriate authority, resources, and guidelines and held responsible for program accomplishment. Program managers will report to an associate administrator or myself and will provide program reviews directly to me and the ASARC on a regular basis. I will retain sole approval authority for schedule changes and funding revisions.

And five, implement new procedures for program managers to "contract" their work with FAA line organizations. This will enable the program managers to utilize across-the-board FAA expertise on major programs. This contract will specify the work to be accomplished, and the resources allocated for the work. Both the program manager and the line manager will be appraised on their future performance by how well they meet their schedules and costs. The line organizations will be held accountable for performance on these contracts.

The changes in program management that I have outlined are now being implemented throughout the FAA. The advanced automation program is one example of a major program that will benefit from the improved program management process I have described.

As you know, a special project office has been established within the FAA for this major program. Mr. Val Hunt, who I introduced earlier, on my left, has just recently joined the FAA and has been selected as the program manager. He will serve as the Director, Advanced Automation Program Office, and will be responsible for carrying out that important program.

One final point, Mr. Chairman, I would like to make is on the subject of individuals who make up organizations, whether managerial staff or technical staff. In the end, all organizations and all programs are dependent upon the availability of well-trained, dedicated staff members to carry out our agency missions.

To assure the continued availability of well-qualified managers and technical staff for FAA positions, I started last April to explore various options within the academic community. I have asked the nation's colleges and universities to help train future managers and engineers for the FAA and other aviation organizations. I have asked for the establishment of a curriculum that would provide a basic foundation in the general elements of aviation sciences and lead to a bachelor's degree in airway science, and also offer the possibility of a master's degree.

I believe that expanding participation by colleges and universities will enable both the aviation industry, and particularly the FAA, to broaden the base for recruitment and result in enhancing the development of our work forces. This effort will lead to a significant increase in the trained cadre of future FAA employees at all levels, offer a wider base of capability for future management, and start a fundamental improvement in labor-management relations.

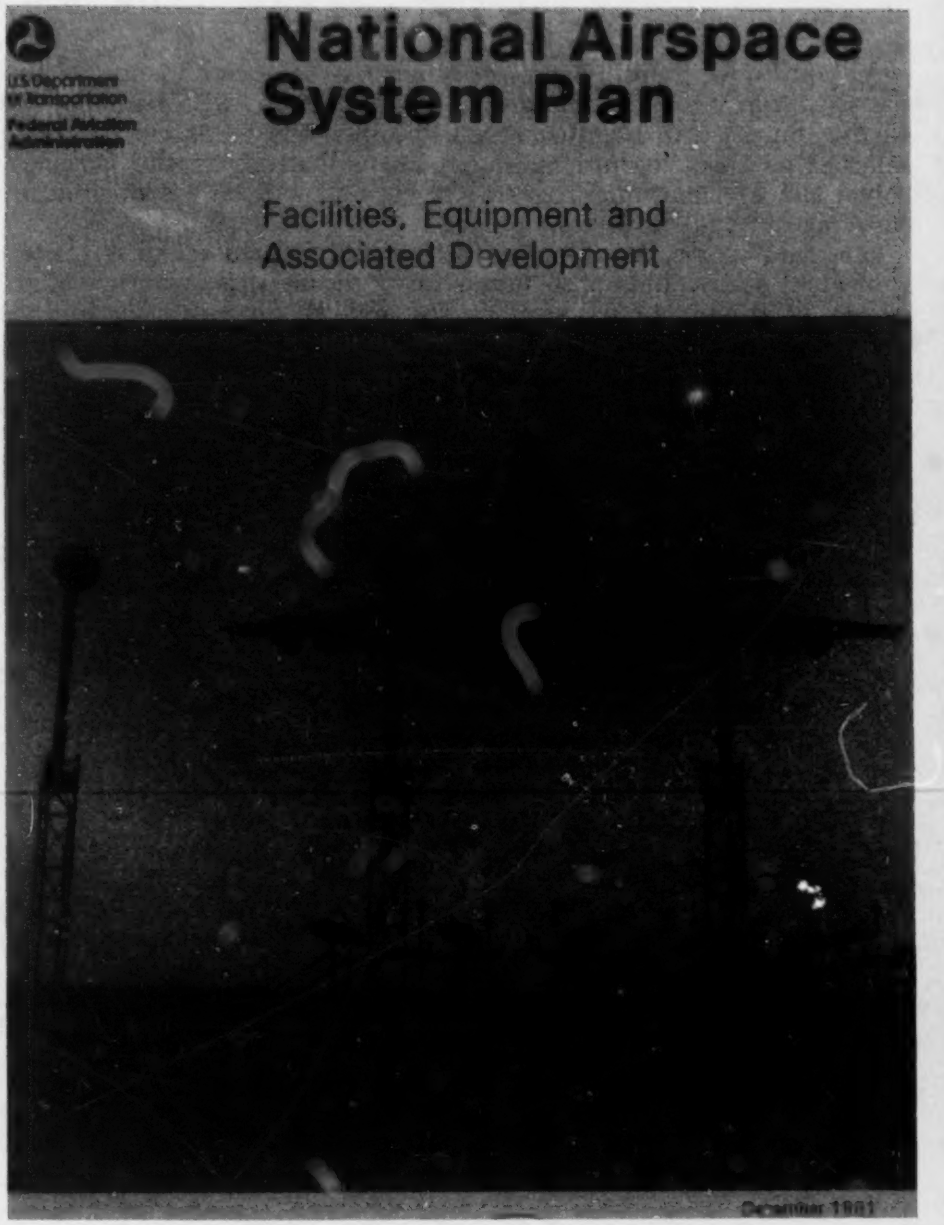
I already have acceptance of this concept by three of our nation's universities. One will have syllabus, staff, facilities and faculty available for student entry this fall.

By this means, I hope this committee, and others in the Congress, can start to see a major change in FAA, including the absolute requirement that we acquire, train, and motivate the people to manage this vital part of our nation's expanding economy.

In summary, Mr. Chairman, we have completed a plan that strikes the best balance possible among the diverse user community of the aviation public. We have restructured our procurement and program management for the plan implementation, and we have initiated a long-term plan of education and training to create a new level of management capability in the future, to ensure that the system is properly maintained and operated throught the turn of the century.

I thank you for your patience for this long statement, Mr. Chairman, and I now welcome the possibility of answering your questions.

[Slides 1-36 follow:]



U.S. Department of Transportation
Federal Aviation Administration

National Airspace System Plan

Facilities, Equipment and Associated Development

December 1981

SLIDE 1

Guiding Principles

- Control But Not Constrain
- Regulate But Not Interfere
- Recognize That Most Air Travelers Do So by Scheduled Air Carriers. We Have a Responsibility to Consider Their Priority But Not to the Extent That It Excludes the Single Individual from Enjoying Man's Greatest Achievement: SOLO FLIGHT

SLIDE 2

System Evolution

1930's	Procedural Voice Position Reporting
1950's	Introduction of Radar Independent Flight Monitoring
1960's	Introduction of Automation
1980's	Use of Technology for Productivity,

SLIDE 3

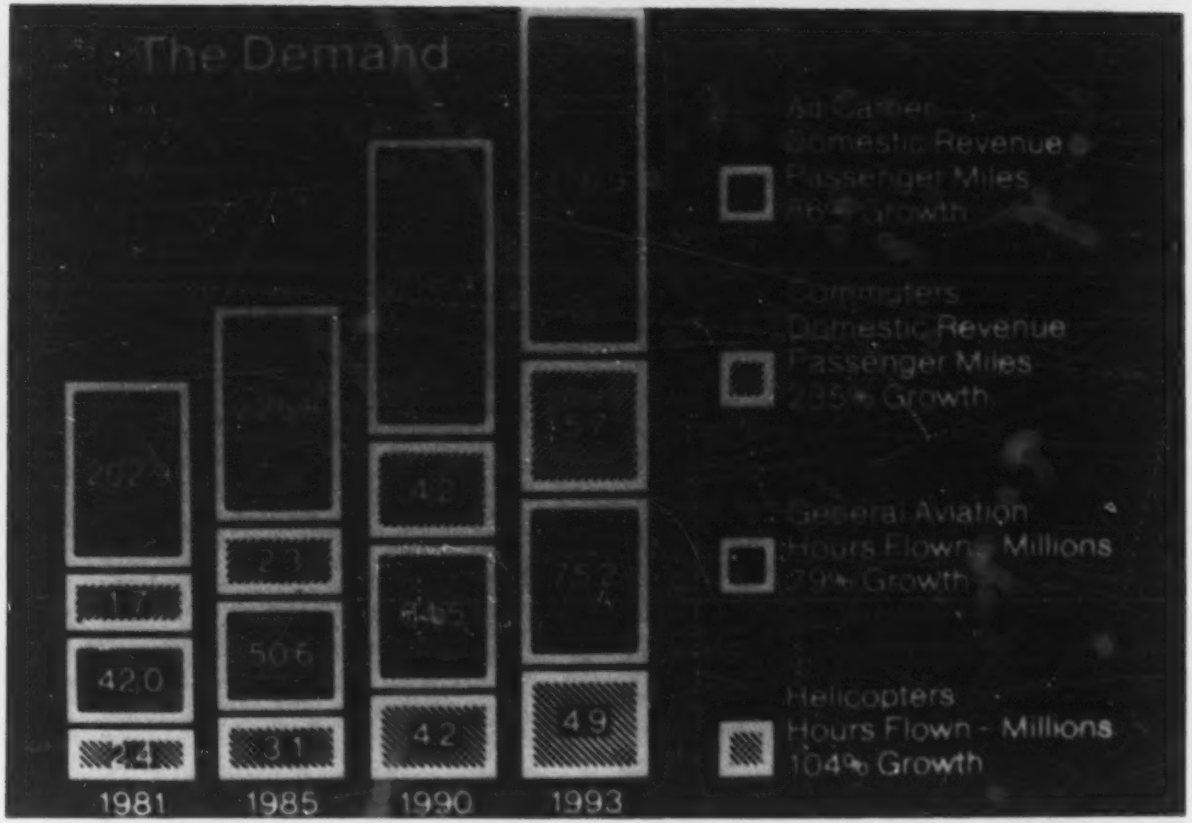
Distribution of Today's System

25	En Route Control Centers
184	Automated Terminal Facilities
317	Flight Service Stations
3	Major Data Switching Centers
3187	Technical Facilities Locations
	Communications
	Radar
	Navigation

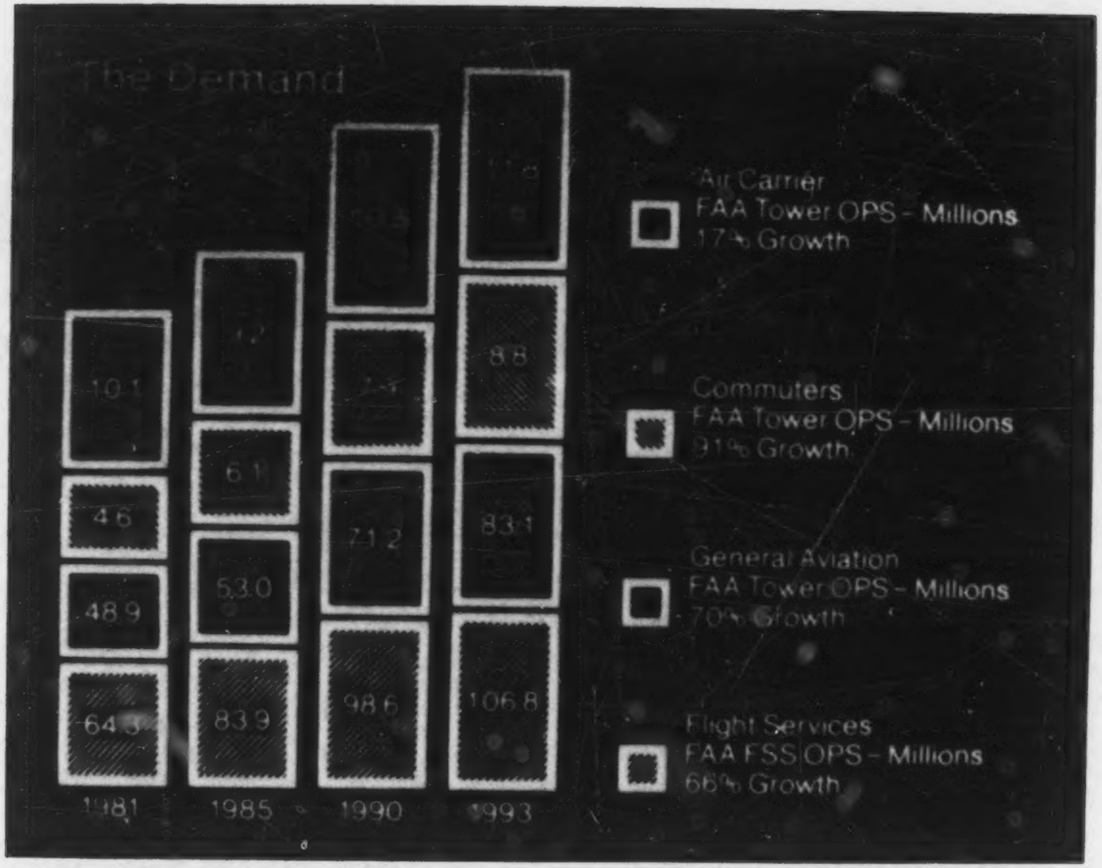
SLIDE 4

The Future Drivers

- Growth in Demand
- Constrain Costs
- Recast the Technical Framework
  Simple Extension Will Not Yield Needed Benefits
- Deal with Problems of Aging Facilities


The Demand
202.9
1.7
42.0
2.4
2.3
50.6
3.1
4.2
44.5
4.2
5.7
75.2
4.9
1981
1985
1990
1993
Air Carrier
Domestic Revenue
Passenger Miles
86% Growth
Commuters
Domestic Revenue
Passenger Miles
235% Growth
General Aviation
Hours Flown - Millions
79% Growth
Helicopters
Hours Flown - Millions
104% Growth

Slide 6


The Demand

Air Carrier
FAA Tower OPS - Millions
17% Growth

Commuters
FAA Tower OPS - Millions
91% Growth

General Aviation
FAA Tower OPS - Millions
70% Growth

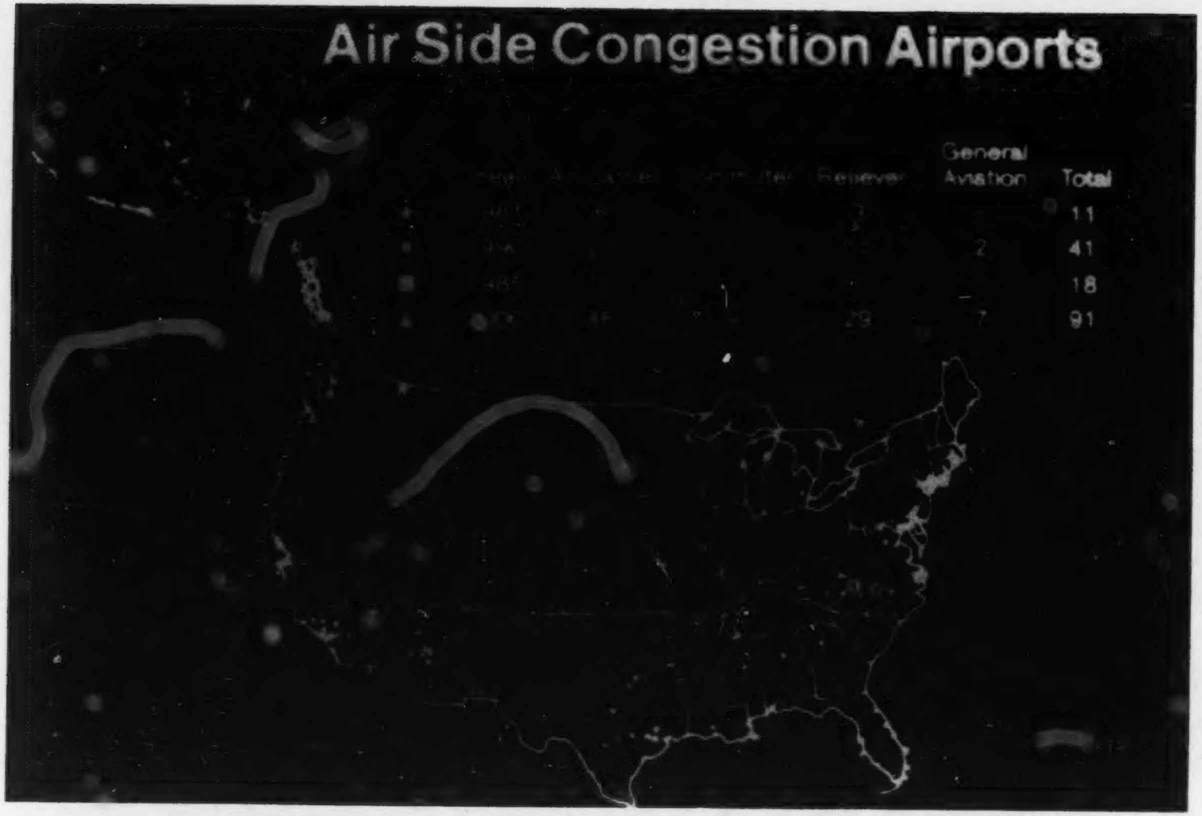
Flight Services
FAA FSS OPS - Millions
66% Growth

Slide 7

Considerations in Meeting Demand

- Major New Airport Construction Will Be Limited
- System Capacity Must Be Provided by Improved Flow Control Procedures, ATC System Improvements and Advanced Automation System
- Improvements Will Continue To Be Implemented, Yet Limited Airport Capacities Will Continue

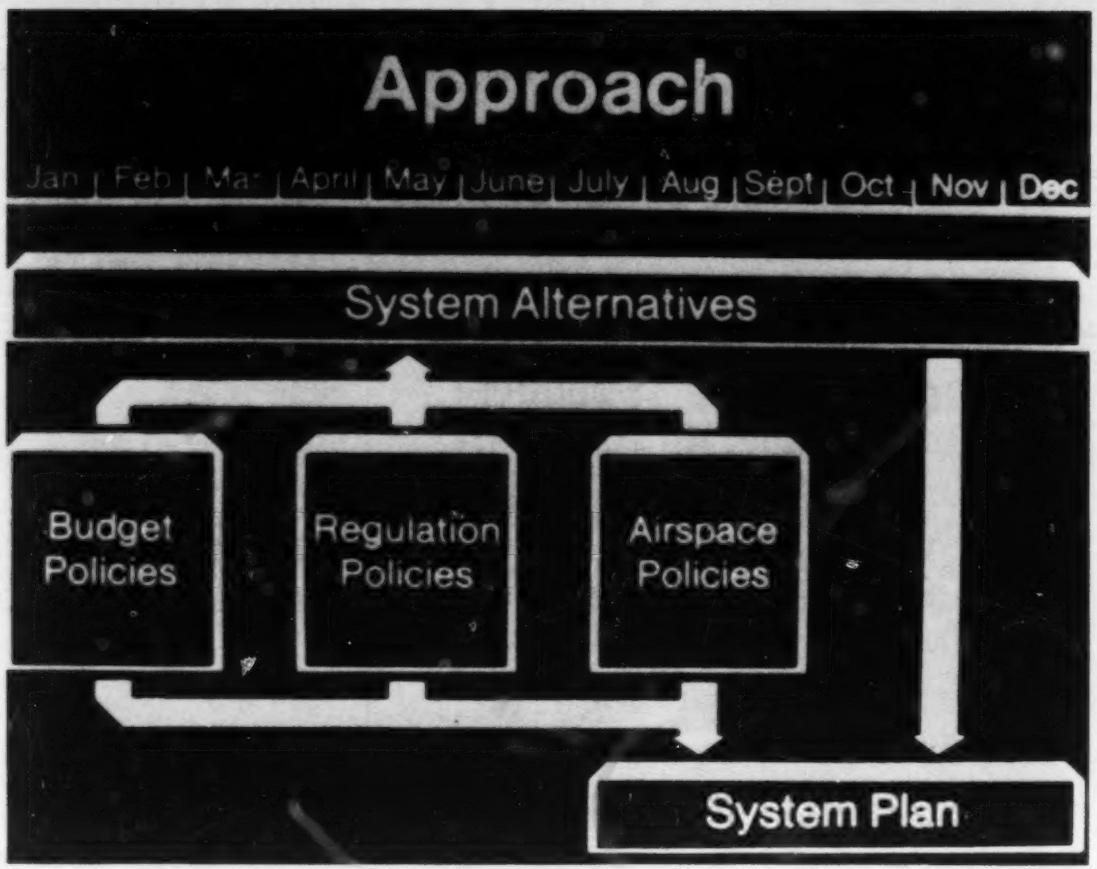
SLIDE 8



Air Side Congestion Airports

	Year	Air Carrier	Commuter	Reliever	General Aviation	Total
[illegible]	[illegible]	[illegible]	[illegible]	2	[illegible]	11
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2	41
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	18
[illegible]	[illegible]	[illegible]	[illegible]	29	7	91

SLIDE 9



Approach

Jan | Feb | Mar | April | May | June | July | Aug | Sept | Oct | Nov | Dec

System Alternatives

Budget Policies

Regulation Policies

Airspace Policies

System Plan

SLIDE 10

The System Plan*

- Evolve and Modernize the Current System
- Provide a Backbone Network of Facilities and Equipment to Support ATC Operations into the Year 2000
- Capture Benefits of Future Capabilities for the ATC System

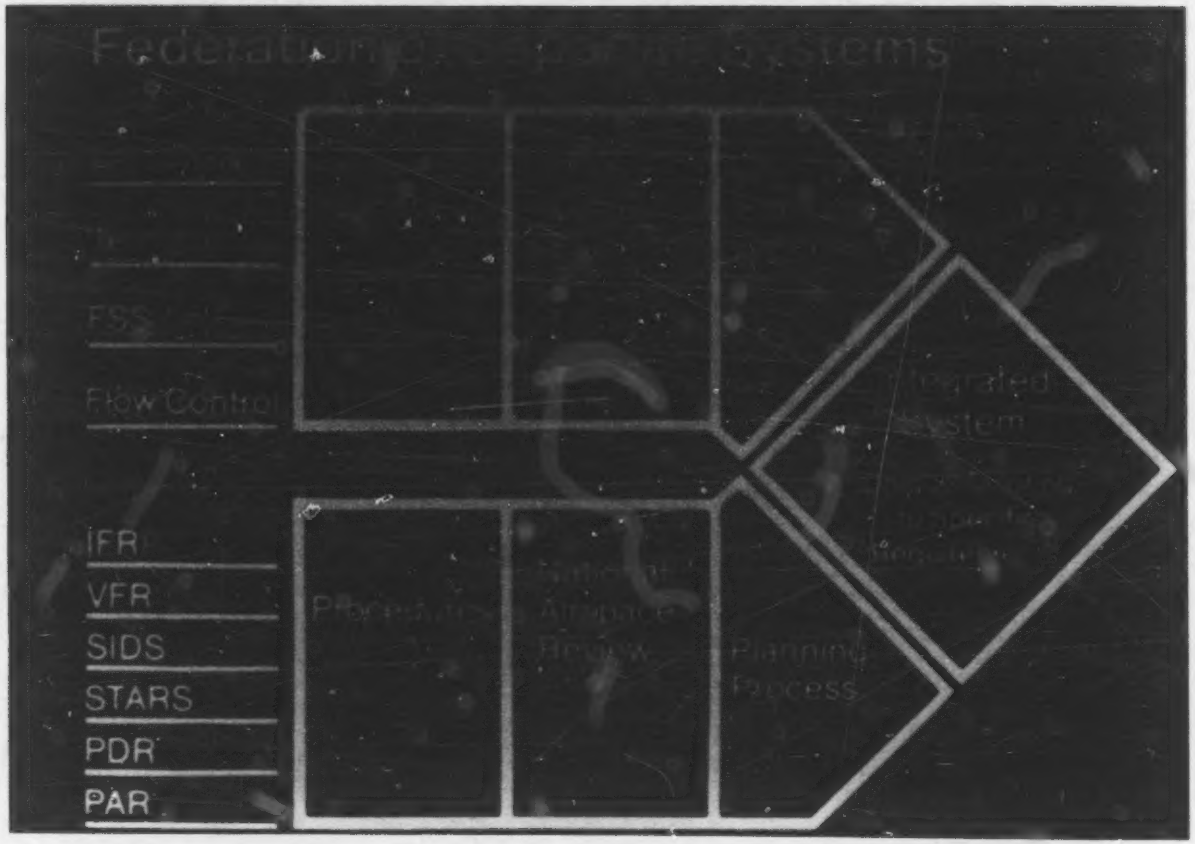
*Equipment and Facilities

National Airspace Review**

- Improve Current ATC Procedures and Airspace Utilization
- Identify Opportunities for Further Improvement in ATC Procedures and Airspace Utilization Resulting from Planned System Improvements

**Policy and Procedures

Federation of [illegible] Systems



FSS

Flow Control

IFR

VFR

SIDS

STARS

PDR

PAR

Procedures

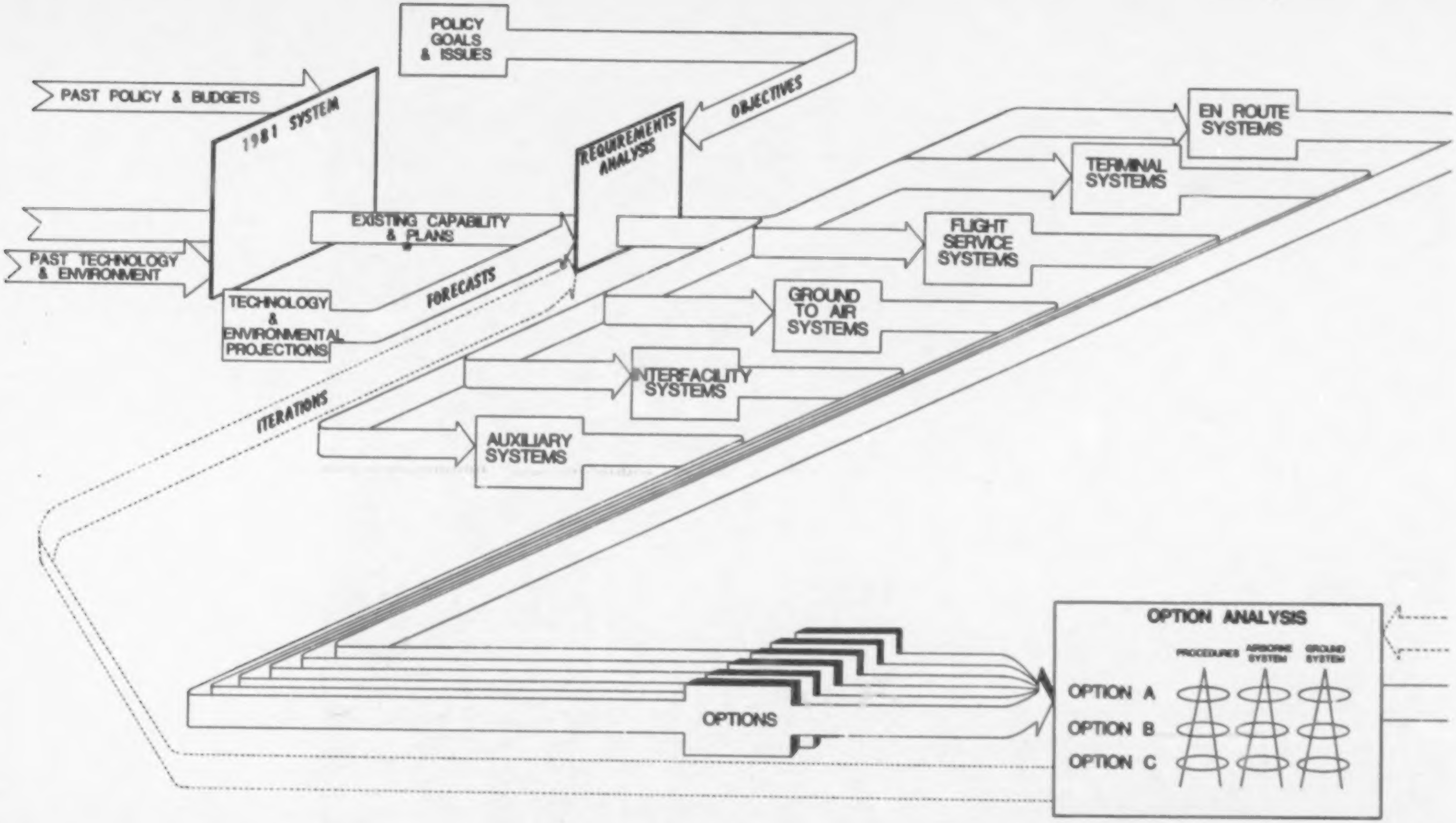
[illegible] Airspace Review

Planning Process

Integrated System

[illegible]

Slide 12



PAST POLICY & BUDGETS

PAST TECHNOLOGY & ENVIRONMENT

1981 SYSTEM

POLICY GOALS & ISSUES

OBJECTIVES

REQUIREMENTS ANALYSIS

EXISTING CAPABILITY & PLANS

TECHNOLOGY & ENVIRONMENTAL PROJECTIONS

FORECASTS

ITERATIONS

EN ROUTE SYSTEMS

TERMINAL SYSTEMS

FLIGHT SERVICE SYSTEMS

GROUND TO AIR SYSTEMS

INTERFACILITY SYSTEMS

AUXILIARY SYSTEMS

OPTIONS

OPTION ANALYSIS

PROCEDURES

AIRBORNE SYSTEM

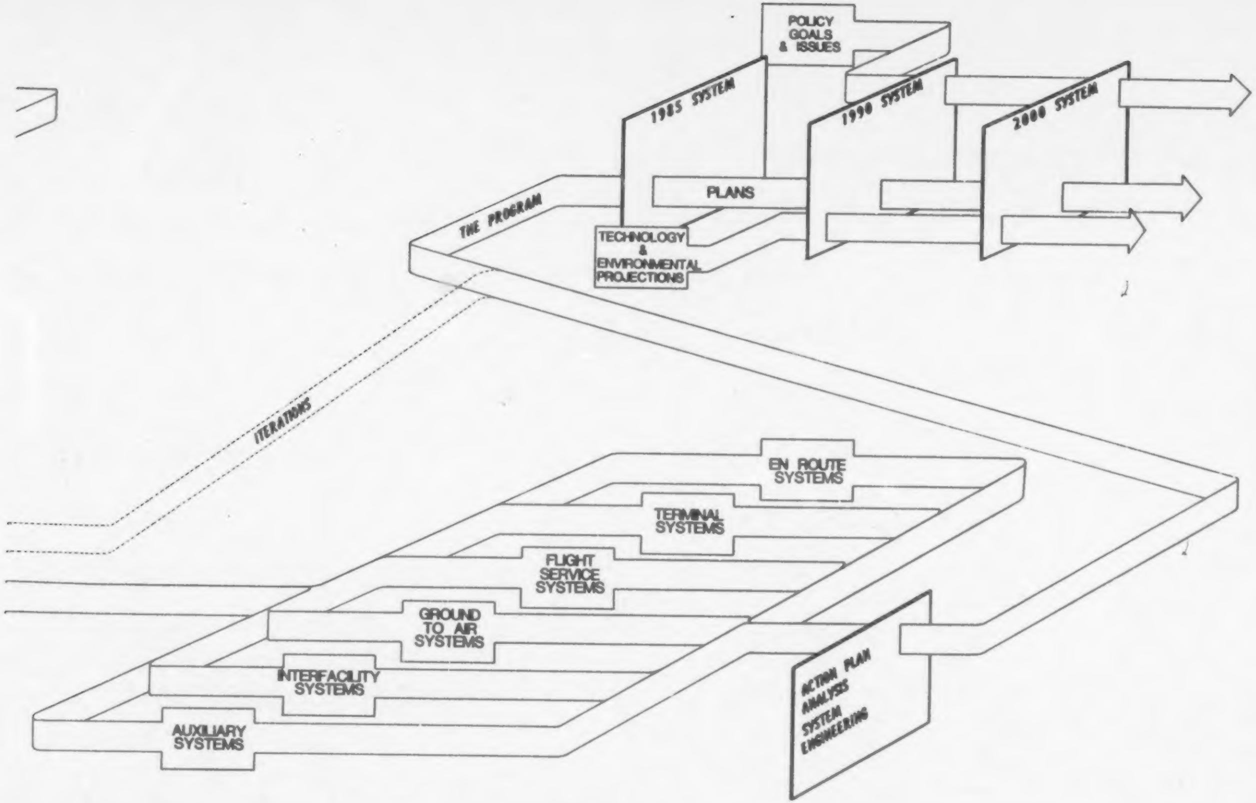
GROUND SYSTEM

OPTION A

OPTION B

OPTION C

Slide 13


POLICY GOALS & ISSUES
1985 SYSTEM
1990 SYSTEM
2000 SYSTEM
THE PROGRAM
PLANS
TECHNOLOGY & ENVIRONMENTAL PROJECTIONS
ITERATIONS
EN ROUTE SYSTEMS
TERMINAL SYSTEMS
FLIGHT SERVICE SYSTEMS
GROUND TO AIR SYSTEMS
INTERFACILITY SYSTEMS
AUXILIARY SYSTEMS
ACTION PLAN
ANALYSIS
SYSTEM ENGINEERING

Slide 14

Typical System Reviews

*Computer Modernization
Navigation
Flight Service Stations
Data Link
Communications
GPS
MLS
Collision Avoidance/ATARS/BCAS
Cockpit Display of Traffic Information
JTIDS

Radar
DABS/Mode S
TIDS
ETABS
*Weather
Oceanic ATC
Helicopter
AERA
Integrated Flow Management
Automatic Tower System

The Policy Emphasis

- Total System Approach
  Flexible Enough to Accommodate Future Demands and Technology
  Accommodate Increasing Rotary Wing Operations

- Improve Vital Safety Services
  e.g., Collision Avoidance, Weather, Landing Systems

- System Evolution
  Integrated Air Traffic Control System
  Commonality of System Components
  Operationsl Flexibility
  Expandability

SLIDE 16

The Policy Emphasis (Cont'd)

- Maximum Use of Automation
  Productivity and Capacity
- Consolidation
  Modern Telecommunications to Capture Economies of Scale
- Modernize 20 + Year Old Plant
  Mixture of Selective Refurbishment, Replacement, Elimination and New Technology
- Local Sponsorship of Services and Facilities Best Provided Non-Federally
- Overlay Independent Airborne Collision Avoidance Capability
  TCAS

Structure of the Plan

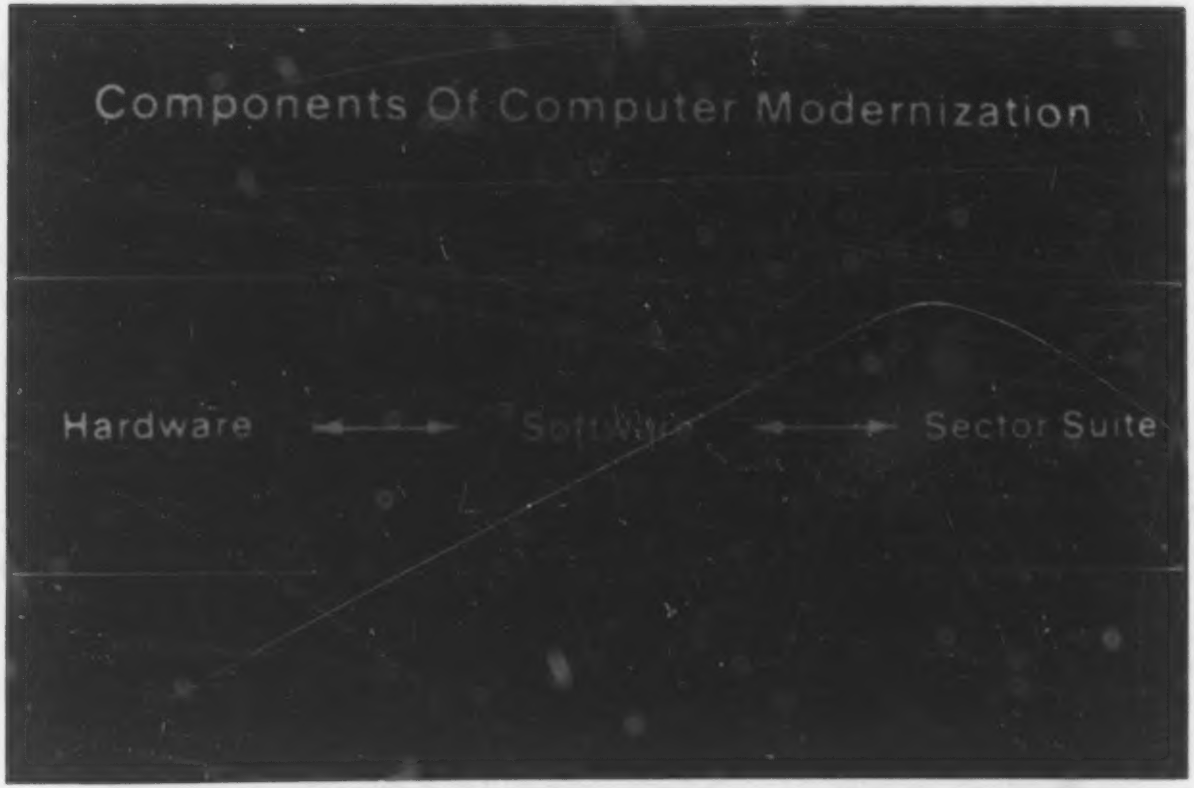
Chapter	Title
I	Overview
II	Demand on the System
III	En Route System
IV	Terminal System
V	Flight Service System
VI	Ground to Air System
VII	Interfacility Communications System
VIII	Auxiliary System

Slide 18

Chapter III & IV —
En Route and Terminal Systems

THRUST

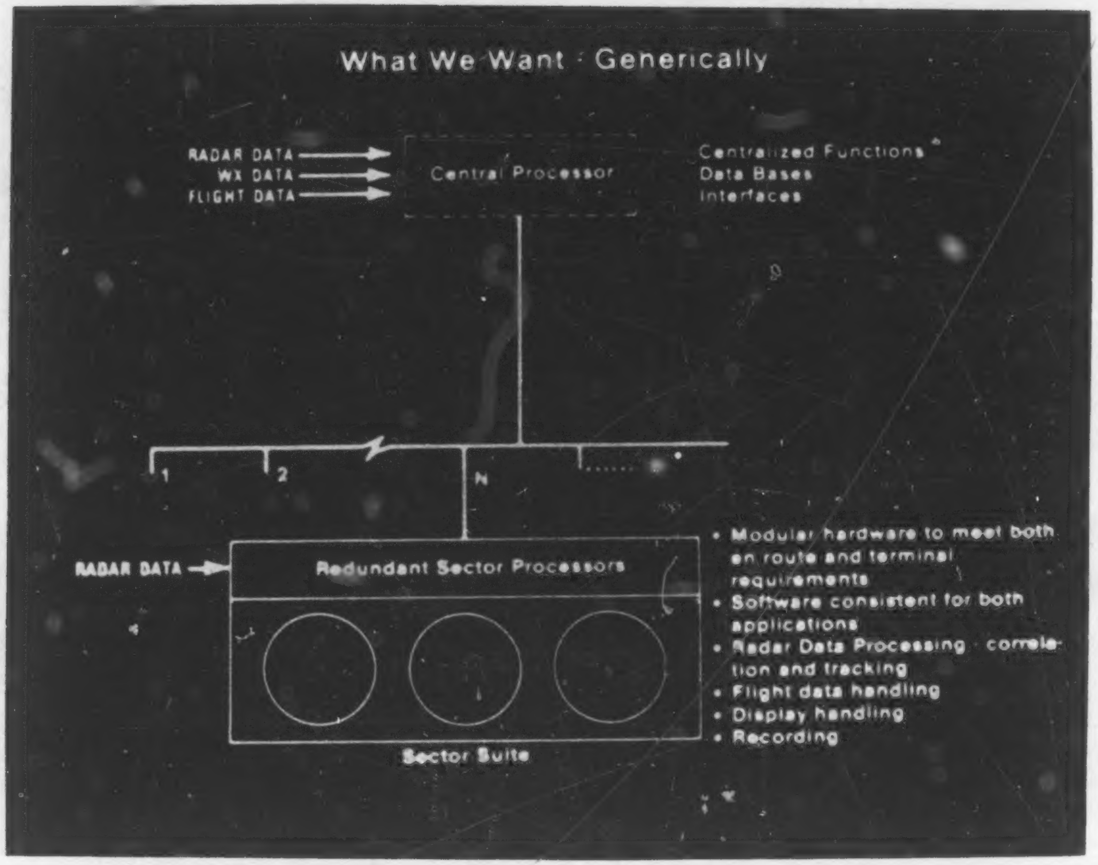
- Consolidation of Major Facilities
  209 Operations Centers Consolidated to About 60
- Common Modular Computers and Software
  Satisfy a Range of Needs
- Automation
  Use of Automation Aids to Achieve Enhanced
  Safety, Capacity, and Productivity



Components Of Computer Modernization

Hardware ⟷ Software ⟷ Sector Suite

Slide 20



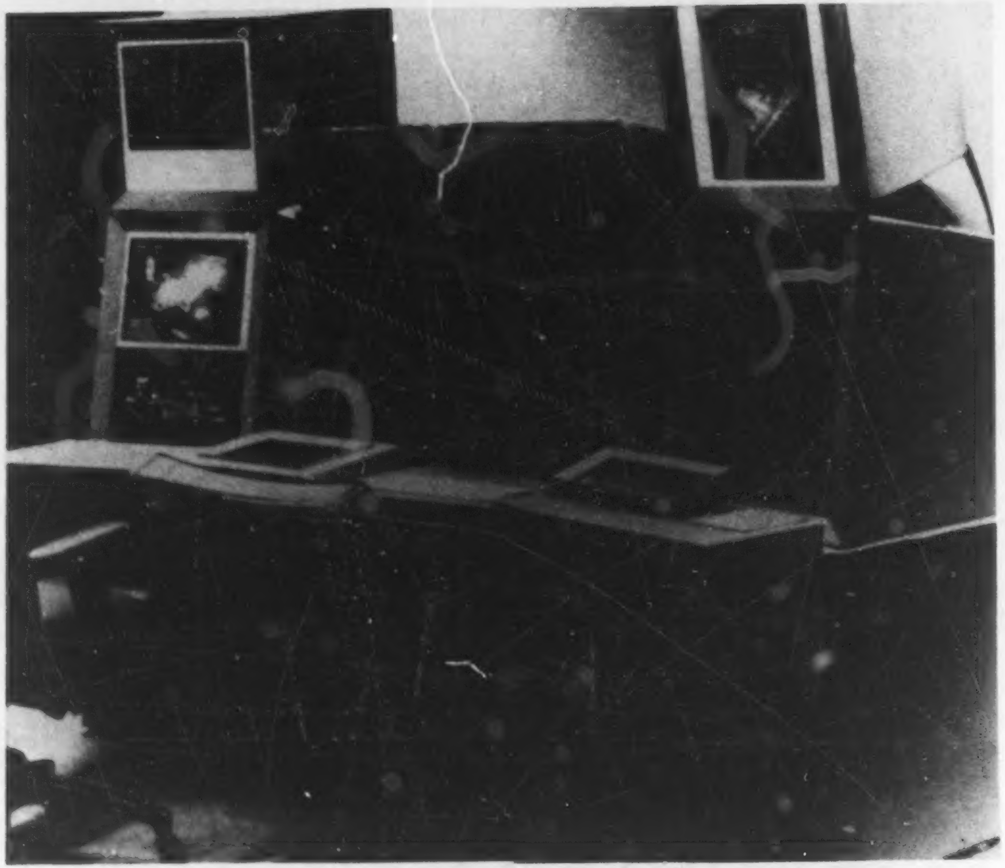
What We Want · Generically

RADAR DATA
WX DATA
FLIGHT DATA
Central Processor
1
2
N
RADAR DATA
Redundant Sector Processors
Sector Suite

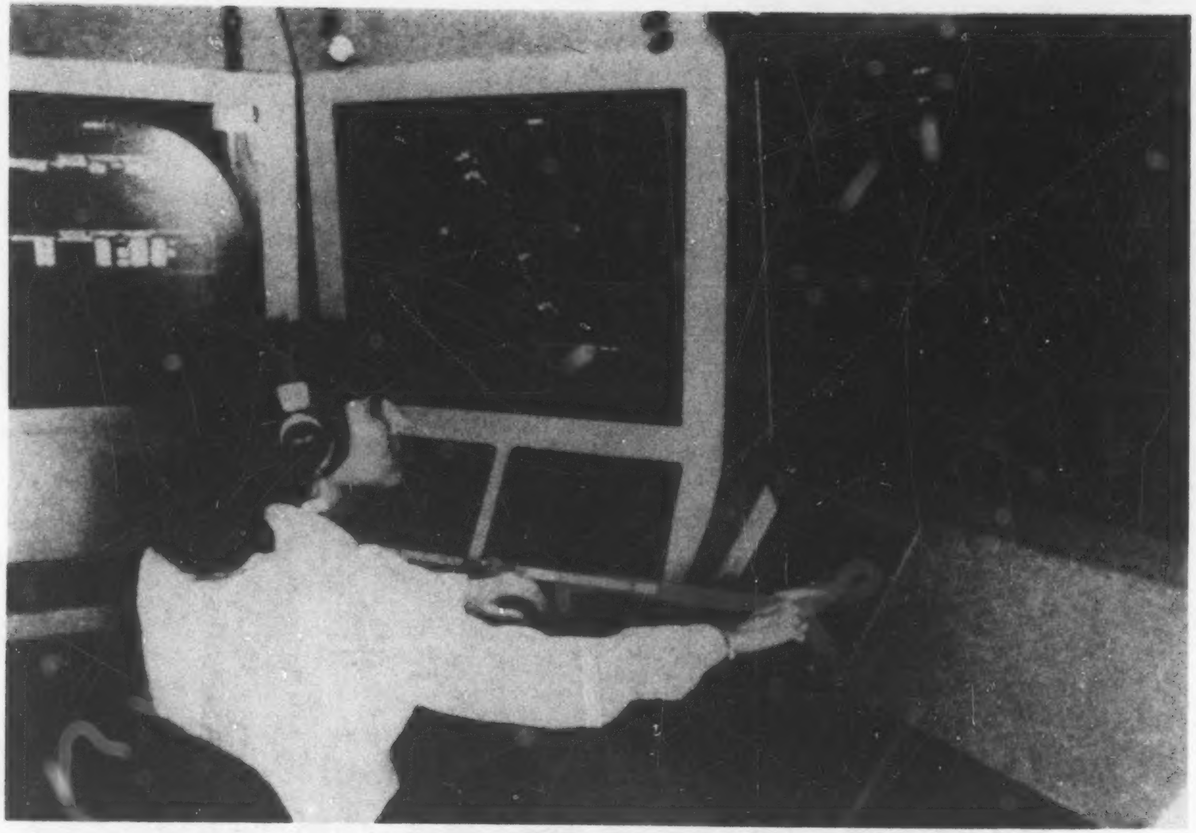
Centralized Functions
Data Bases
Interfaces

- Modular hardware to meet both en route and terminal requirements
- Software consistent for both applications
- Radar Data Processing · correlation and tracking
- Flight data handling
- Display handling
- Recording

Slide 21



Slide 22



SLIDE 23

Functional Improvements

— **Near Term**

1. Conflict Alert for VFR Intruders (CA VFR)
2. Conflict Resolution Advisory (CRA)
3. En Route Metering (ERM)
4. En Route Tabular Display System (ETABS)*
5. DABS Interface
6. Center Weather Service Unit (CWSU) Interface
7. Terminal Information Display System (TIDS) Interface

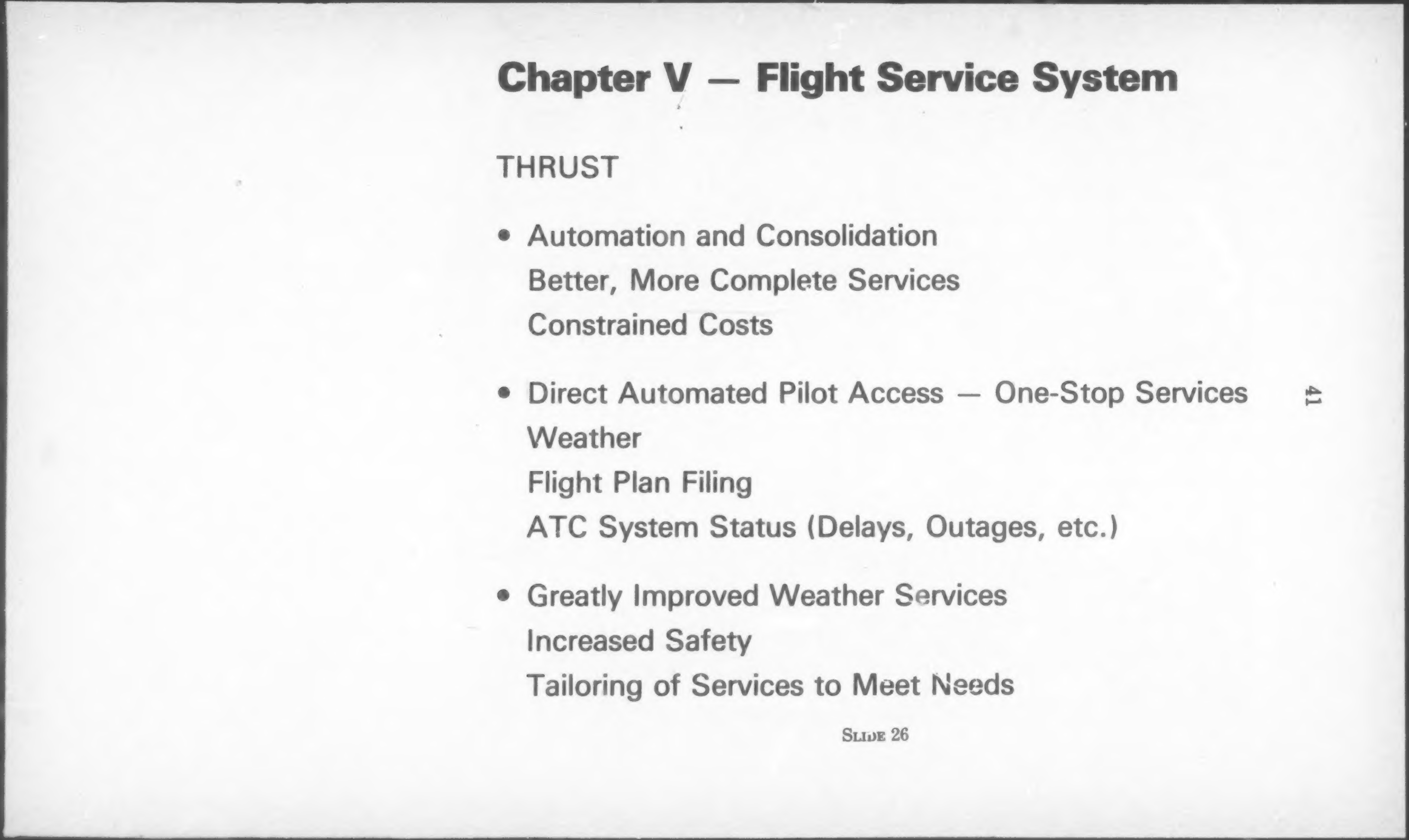
— **Long Term**

8. Direct/Fuel Efficient En Route Planning
9. Flow Planning and Traffic Management
10. Strategic Clearance Planning
11. Full Tactical Clearance Generation and Execution

* Includes Automated "D" Position Planning Function

AERA Benefits

	Functional Improvements	Benefits
AERA-1	(8) Fuel Efficient Route Planning	3% Fuel
	(9) Flow Planning and Traffic Mgmt.	
AERA-2	(10) Strategic Clearance Planning	1½% Fuel
	(11) Full Tactical Clearance Generation and Execution	35% En Route Controllers
		Automated Safety Enhancements (60% Reduction in System Errors)

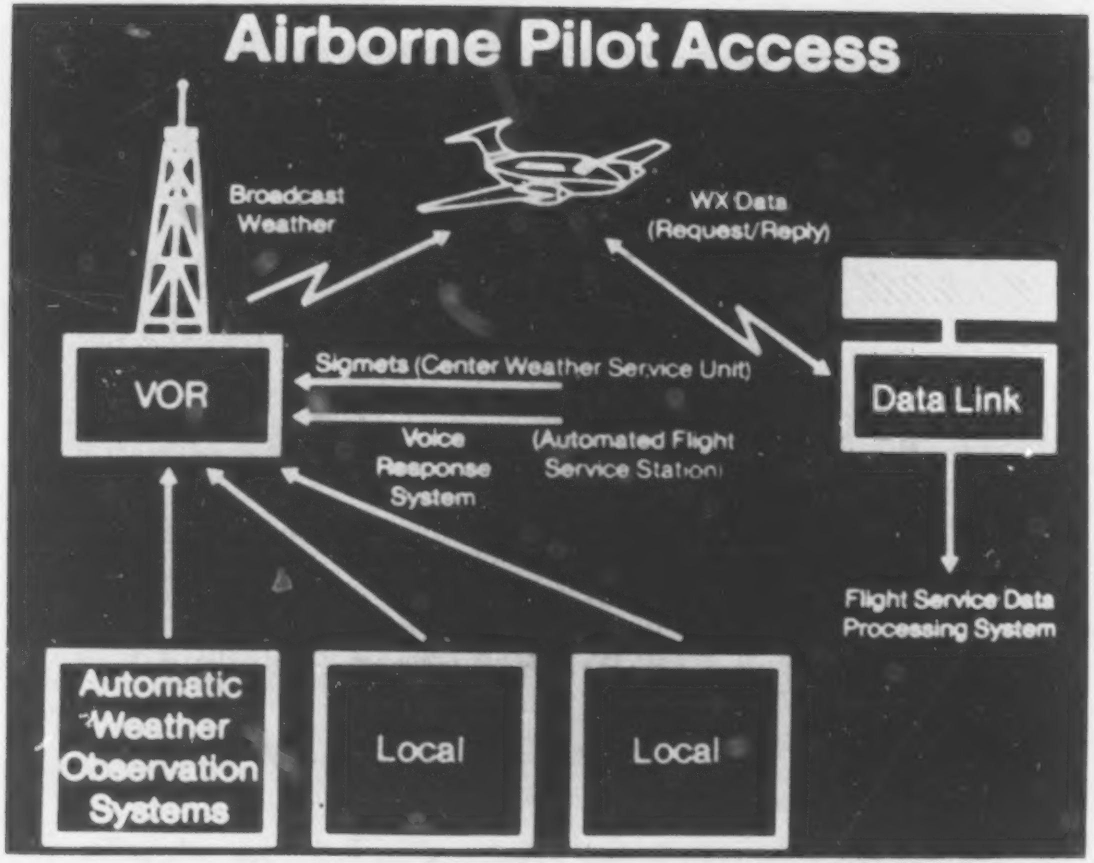


Chapter V — Flight Service System

THRUST

- Automation and Consolidation
  Better, More Complete Services
  Constrained Costs
- Direct Automated Pilot Access — One-Stop Services
  Weather
  Flight Plan Filing
  ATC System Status (Delays, Outages, etc.)
- Greatly Improved Weather Services
  Increased Safety
  Tailoring of Services to Meet Needs

Slide 26



Airborne Pilot Access

Broadcast Weather

WX Data (Request/Reply)

VOR

Sigmets (Center Weather Service Unit)

Voice Response System

(Automated Flight Service Station)

Data Link

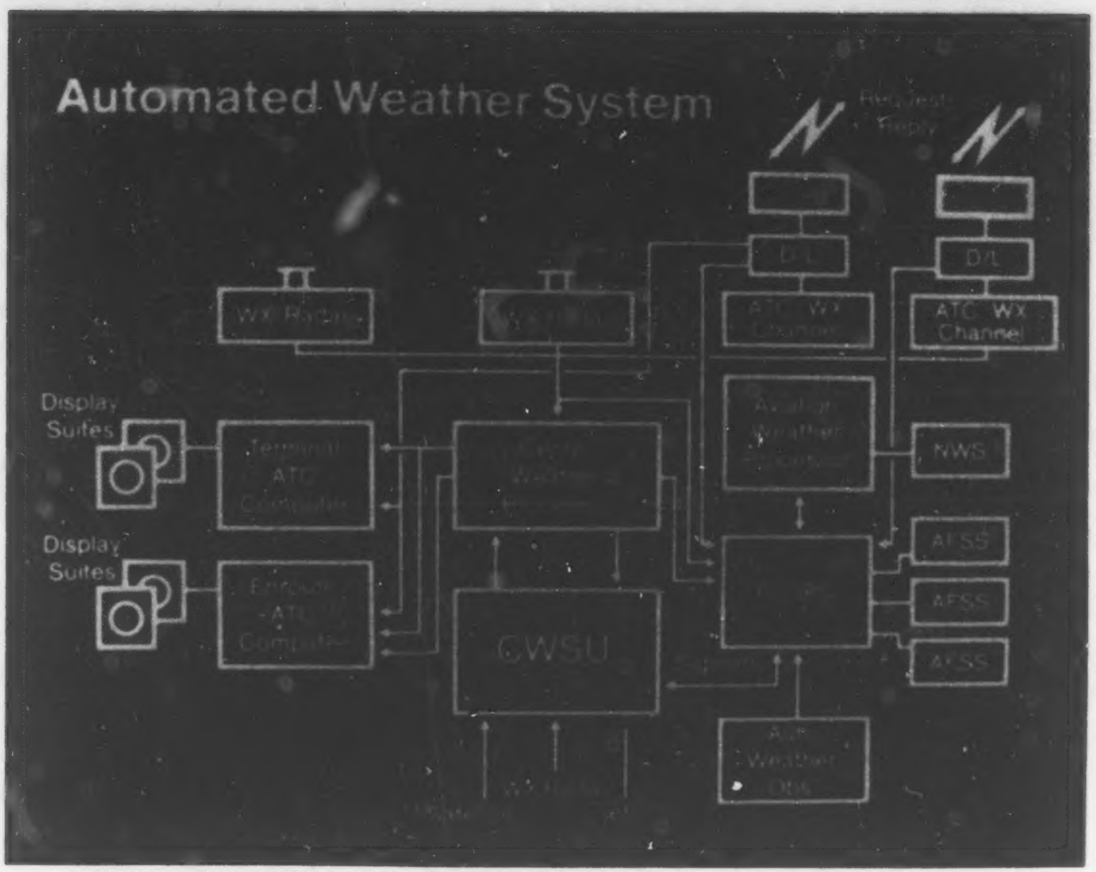
Flight Service Data Processing System

Automatic Weather Observation Systems

Local

Local

Slide 27



Automated Weather System

Request
Reply
D/L
D/L
WX Radars
ATC WX Channel
ATC WX Channel
Display Suites
Terminal ATC Computer
Display Suites
Enroute ATC Computer
Aviation Weather Processor
NWS
AFSS
AFSS
AFSS
CWSU
Auto Weather Obs

Slide 28

Chapter VI — Ground to Air System

THRUST

- Major Consolidation of Unmanned Facilities
  From Approximately 3200 Down to 1800
  Extensive Use of Remote Maintenance Monitoring

- Elimination of Redundant and Separate Radar and Communication Facilities
  Establishment of Integrated Networks

- Capture Benefits of MLS
  Minimize ILS Procurement

- Replace Planned DABS System with a Compatible, but Simpler Surveillance/Data Link Design (Mode S) at One-Third the Cost

Chapter VII —
Interfacility Communications System

THRUST

- Integrated Telecommunications Network Potential Use by Other DOT Elements

- Mix of Communication Facilities

  Owned

  Leased

  Satellites

- Take Advantage of Rapidly Changing and Lower Cost Technologies in Telecommunications

SLIDE 30

Chapter VIII — Auxiliary System

THRUST

- Reduce Airway Facilities Maintenance Costs
  - Consolidation of Work Centers and Manned Facilities
  - Remote Maintenance Monitoring of All Remote Facilities Allowing Maintenance Staffing Reduction
  - Reduction of Support Costs, FAA Owned Housing and Plant Facilities
  - Improved Field Training Through Computer Based Instruction

- Reduce Flight Inspection Costs
  - Reduce Number of Flight Inspection Field Offices Through Consolidation
  - Reduce Flight Inspection, Aircraft Flight Time and Fuel Consumption

System Results

- Accommodate Demand without Constraint
- Increased Freedom of Flight
- Improve Vital Safety Services
- Improve Productivity
    - Controllers
    - Maintenance Personnel
    - Overhead
- Reduce Federal Role Where Industry and Local Communities Can Better Provide Services
- Constrain Operating Costs

Mr. **Glickman**. I want to thank you for your excellent testimony.

We have had some additional Members come into the room, Congressman Dymally from the Los Angeles area and Congressman Hollenbeck from New Jersey.

I am going to let Congressman Shamansky begin the questions.

Mr. **Shamansky**. Thank you, Mr. Chairman.

Mr. Helms, I don't mind saying that anything like this I find thoroughly intimidating, just by the very nature of it, so my comments have to be comments because there is no way for me to absorb all of that, even from your excellent presentation, so I ask you to be patient with me.

My first comment is that when I came across, in the introductory remarks, very early in your presentation, the reference you made to "man's greatest achievement," I instantly thought of a happy marriage, and you said solo flight. [Laughter.]

Now, there is a problem there for me. If you are serious in presenting to the American public that man's greatest achievement is solo flight, I would suggest that is a bit of ethnocentrism or some egocentrism that is going to put off, say, a lawyer like me as distinguished from a fellow in general aviation who likes to fly in his own plane. If that is the tradeoff, we have got to do all this so a fellow can have recreational flying as man's greatest achievement, I think that is a skewed set of values and tough to sell.

Mr. **Helms**. Mr. Shamansky, I have found that every person is a prisoner of his background, and there is conceivably a little bias in my view that that is man's greatest achievement.

The distinction between comparing that and marriage is, after 35 years, I have concluded that I did not create my marriage; it was created in heaven; God did that. Therefore, I am not comparing that with man's greatest achievement.

Mr. **Shamansky**. Well, now that we have stepped down from that. [Laughter.]

You still have a problem, I suggest to you. You can write your reports or whatever you want to; I am saying that is a tough sell, and it is instantly going to irritate the likes of me, if that is what the value is, that that is man's greatest achievement. I do not want to dwell on it, but I think it is a very special pleading.

Now, when I came across to one of the diagrams, and you had facilities and procedures, and they came together in the planning process, my immediate thought was, "What else?" I cannot think of any other division in a planning process in this area. You have facilities and you have to figure out how to use them.

As I say, I do not mean to denigrate this. It is a little bit like the Emperor's clothes. Watching, I think you have gone through those steps. As a lawyer, I am paid—I am a lawyer in real life, as distinguished from whatever this is. [Laughter.]

To get to the heart of the matter as quickly as possible, what is the issue? So I think how you use the procedures, what procedure you use to utilize the facilities I think is implicitly inherent; what else is there? I really think that you seem to have done a good job. I am glad you have done it, but I cannot imagine what else you would have done.

With respect to the complications of it, I come from a liberal arts background. I have just mastered the bicycle, so I have a problem here with this advanced stuff. But you noticeably in your presentation have not mentioned cost. It seems to me, even at this date, especially when you say, as a principle, the major burden will be on the user, which I think, as a general principle, is excellent—I think that is what we are going to have to do more and more of. Now, whether it comes to barges on our inland waterways or those of us who drive over highways in cars and trucks, we ought to relate the cost to the user, if at all possible.

But I think it is perfectly obvious in your presentation, you have made—I cannot believe you have done all of this without having assayed some costs. I just refuse to believe it. Yet you have not mentioned it, and I do not know why.

Mr. HELMS. We are still in the process of establishing the details. We forecasted out for 5 years. Our projection for the F. & E. cost, which is what this would be, the facilities and equipment, of 1982 through 1987, is about $7 billion, Mr. Shamansky, plus or minus 10 percent.

At the end of that time, the aviation trust fund would have approximately $1 billion remaining, and that is based on a tax plan which would include 12 cents in aviation gasoline and 2 cents a year expansion of that—that is, increase—14 cents a gallon on jet fuel and 2 cents a year increase; 8-percent ticket tax; a 5-percent waybill tax; a $3 per head international departure tax; the others being the same as we have had in the past.

So it is included and will be submitted in detail later. I expect to have the final numbers broken down by each year and each segment within the next 2 weeks, per the chairman's request, and we will so submit them. [See appendix.]

I accept, Mr. Shamansky, your comment that you must have detailed cost data.

Mr. SHAMANSKY. Thank you.

The other comment I would like to make before relinquishing the questioning is your, I think, proper emphasis on the necessity of obtaining qualified—that is, trained—personnel. You said that you had contacted colleges and universities.

I would like to comment, sir, that we on this committee are facing a decision by the administration to, in effect, wipe out science and engineering education assistance. It is not just in science and engineering; we are cutting back, for instance, guaranteed student loans to graduate students.

I think that the administration is going to have to resolve the question of the role of education in our national approach to the future.

One of my particular interests is the fact that the administration still supports tobacco subsidies. I think that is ridiculous, in contrast to this. I just use that as a concrete illustration of conscious choices.

Now, there is no way for you to come here and say, "We've got to have these students," and then Mr. Stockman make fun of aid to education by referring to $100,000 families, which may constitute 1 or 2 percent of the population.

Mr. HELMS. Well, I obviously am not in a position, or it is not within my authority or responsibility, to try to approach it on a national level, but I can do it on this basis: Even though I will only be here for this administration, I feel an obligation to this country that transcends this position. I have benefited from it very well, and I specifically, at my own initiation, contacted a number of universities with a view toward trying to help that university in that area.

Specifically, I spent considerable time with Dr. Peyton at Tuskegee to show him how, under this program, I think we can set up a program to help blacks in aviation; that has never been done before.

I have also contacted the president of a girls' school in the South with a view toward trying to open this up for women.

So I have tried to use this, to the extent I can, to create job opportunities, but I cannot answer your broader question, Mr. Shamansky.

Mr. **Shamansky**. Mr. Helms, I have to point out to you that the administration, in the area of minorities and women, in that directorate, they wiped that out. So it is commendable, as far as I am concerned, that you have contacted those institutions, but I think you have to face up to the reality that maybe a visit to David Stockman might be useful.

Mr. **Glickman**. I am sure he has talked to David Stockman.

Mr. **Helms**. On a number of occasions, Mr. Chairman. [Laughter.]

Mr. **Shamansky**. What I want to know is, who took whom to the woodshed? I mean, did you take him to the woodshed or did he take you to the woodshed in the process?

Mr. **Helms**. We have both taken up the President's habit of chopping wood, Mr. Shamansky. [Laughter.]

Mr. **Shamansky**. That is not answering my question, sir, but that is all right.

Thank you, Mr. Helms. It was an excellent presentation, but I think, obviously, and I am sure you expected this, it raised as many—I cannot say it raised as many questions as it answered, but there are some tough questions yet to answer.

Mr. **Helms**. Yes, sir, I acknowledge that.

Mr. **Shamansky**. Thank you very much.

Mr. **Glickman**. Perhaps, after figuring out what man's greatest achievement is, maybe I had better ask the next few questions.

I would like to basically ask you a couple of things. You indicated to Mr. Shamansky—I do not want him to believe that you are not cognizant of cost issues—that you were talking about a multibillion-dollar projected investment.

Mr. **Helms**. Yes, sir.

Mr. **Glickman**. In fact, I believe it is the largest computer purchase ever made by the Government, other than the Defense Department, and probably the largest capital expenditure in equipment ever made by the Government except in defense.

Mr. **Helms**. And probably less than Apollo, which is the space program, but other than that, yes, the total program approach is that size, Mr. Chairman.

Mr. **Glickman**. OK. Now, pursuant to House Resolution 202, which this committee enacted some time ago, largely due to the efforts of Mr. Dunn, at some point in time, you are going to bring to us year-by-year costs of the various components, what your request will be in terms of the new airport airways trust fund bill, what tax structure you will recommend, and the consistency of all of these things—tax, ADAP expenditures, appropriation requests, and the funding projections. I assume you will have that on some sort of computer printout or something for us as soon as possible.

Mr. HELMS. Yes, sir, Mr. Chairman, we do plan to do that, and I would expect it within approximately 2 weeks. You will have that in your hands. [See appendix.]

Mr. GLICKMAN. OK. Now, you did mention today, in answer to Mr. Shamansky, projected tax structure. You talked about, I believe, a 12-cent——

Mr. HELMS. Aviation gasoline.

Mr. GLICKMAN. Up 2 cents——

Mr. HELMS. Per year.

Mr. GLICKMAN [continuing]. Per year, and a 14-cent jet fuel, also up——

Mr. HELMS. Yes, sir.

Mr. GLICKMAN [continuing]. And an 8-cent ticket tax.

Mr. HELMS. Eight percent.

Mr. GLICKMAN. Eight percent, I am sorry. That, of course, is based upon the President's budget request.

Mr. HELMS. Yes, sir.

Mr. GLICKMAN. Now, realizing, of course, that Congress may not approve those numbers as you have stated today, is it your understanding that all your projections are going to be based upon those numbers that the President sent down some time ago?

Mr. HELMS. The administration will submit a total package to the Congress, and the data which will be submitted to this committee and the others will be submitted on the basis of that tax plan, Mr. Chairman.

I would not presume, of course, to try to tell the Congress what they elect to do on it, but these two must be tied in, and we will in fact submit a total plan for both revenue generation and the expenditures.

Mr. GLICKMAN. OK. We do want those numbers as soon as you can get them. I assume that you are going to take the message to OMB that we need to have an ADAP bill as quickly as possible. You talk about concrete, we are not going to be able to do anything in this country until——

Mr. HELMS. Yes, sir. We will do that posthaste, Mr. Chairman.

Mr. GLICKMAN. My next question is, you talked about current technology, basically, on your vu-graphs, you showed that what you essentially decided is you were going to advance the state-of-the-art technology and implement it into all of the basic systems that you were talking about.

Do you leave yourself open with enough flexibility to adapt to new technologies as they come along? For example, you talked about the fact that you decided not to go with satellites, at least initially. Do you leave yourself open to use satellites as an aid in surveillance and precision approach later on? I am a little worried that because the state-of-the-art is moving so quickly, particularly in computer technology, you might leave yourself behind. I just want to know that you have adaptors all over the process so you can plug in something new.

Mr. **Helms**. The reason for selecting the combination of hardware, software, and sector suite was specifically to allow us to take advantage of growth in computer technology needs by merely substituting hardware 10 years from now if necessary for more computation capacity, but we could not possibly do that with today's software. Software is the limiting item.

Using that as a basis, let me return to the point that the chairman used, satellites. For example, in the details of the book submitted, you will see that in 1986, we start to run into critical areas for air traffic control because of computers. By resectoring—that is, assigning other sectors within the United States to another center—we can shift these around and delay the critical period until 1988. But it clearly says that, starting in 1988, we will have aircraft sitting on the ground because we do not have the capability to process it.

Now, using that as an example, if I say we must have a system in being, operating, and proven by 1990, for example, and we go satellite, that would say that we would have had to have those in production and in installation in the aircraft perhaps in 1988 and 1989 to be there by 1990, which says they would have had to produce them in 1987, which says they would have had to have tooled in 1986, which says that all of their development would have had to be completed in 1985, which says that, by 1984, they would have had to have done their initial R. & D. and compatibility, which says that, by 1983, if you will, the detailed requirements would have had to be established, which says that, in 1982, we would have had to define the amount of precision that is going to be required, which says that, in 1981, we would have had to release the P code out of DOD which would allow us to make a plus or minus 3-meter precision which would be required for a precision approach.

Based on this, I sat down with the Deputy Secretary of Defense and said, "Let's just see now. If you and I had complete authority right now, today, while we are here, how long would it take us to be able to come up with this small box which in fact could interpret between the P code and be used for precision approach in air navigation?"

We concluded that, even if he and I had all the authority in the world, we could not get that box on the market for 24 months. Therefore, it is at the infrastructure; the supporting elements of aviation in this country would not allow us to do this before 1990.

It was based on that, then, that we said we could not go satellite, but we must include the capability to grow into satellite, and that is what we have done, and that is the basis of this plan.

Mr. **Glickman**. OK, and your hardware and software are being designed with the capability of growing into new technology hardware and software, then, particularly software? I guess we have to be more concerned with the software.

Mr. **Helms**. Yes, sir. We think the software will probably last clear up through the turn of the century because we can modify that and we can update it. That is shown in the additional functions that we define, 8 through 11, the advanced automation. That is new software that we can modify at any time.

Then all we would have to do is to buy a higher capacity computer, put it in, and continue to use the displays and upgrade that software. So, yes, we think the approach we have taken will allow us to take advantage of that technology.

I am very concerned about transition, however. As I testified last year, one of the approaches that was recommended, or at least, I should not say recommended but was pointed out by the Senate Investigations Subcommittee, was to consider today's system, tomorrow's system, and maybe we should consider an interim system.

I noted in my concern that we have enough trouble with today's system and planning for tomorrow's. For FAA to manage and integrate and support—software and everything—an interim system, we just could not do it. We do not have that capability.

I am most concerned about the transition, of training our controllers and making sure that we have no slip-up. Let me give you an example of the magnitude of the difference in problem. It is very difficult to get a guaranteed reliability spec out of the computer manufacturers. Rather, they will take the position that, in any 90-day period, our machine will not be out more than 30 minutes. Mr. Chairman, I need a machine that, in a year, will not be out 2 minutes.

Therefore, we are having to go back and take a look at what we can do now with state-of-the-art and, by addressing that portion of the overhead within that computer, make that the aspect for reliability and shifting. It is that type of transition which we will have.

Mr. GLICKMAN. OK, and I assume that, as part of your program management—you have Mr. Hunt here—you in fact have or will have a transition phase down on paper to be able to insure that the system can operate safely while you move to more modern equipment.

Mr. HELMS. Yes, we will, Mr. Chairman. Mr. Hunt was formerly vice president of engineering of a major computer manufacturer, and that was one of the reasons that we proved the point you can get good people into Government if you try hard enough.

Mr. GLICKMAN. You talked about the Department of Defense. One thing I want to make sure of, because I have seen this happen in other elements of Government: We seem to find that certain non-Defense Department agencies are losing their functions, only to find that they are being picked up within the Department of Defense under an elevated and/or enhanced budget structure. Are you picking, within the operation of this NAS plan, any elements that were historically or traditionally operated by the Department of Defense, or vice versa?

Mr. HELMS. No. There is no distinction there. We work very closely with them, but as an overall result of this, there will be some combinations.

For example, at those locations where we establish a major flight service station, the National Weather Service need not keep their people there. They are reducing. So what we are trying to do is go back and make sure that we do not have, for example, at a given airfield, an FAA weather briefer, and if you go down the hall you will find a NOAA weatherman, and if you go across the airfield to the other side of the town, there is a military airfield that has a DOD weatherman.

So to the extent now that we are going through—and I meet regularly with the Deputy Secretary of Commerce, with the Deputy

The Major System Decisions

GENERAL

- ATC Will Continue to Be a Ground-Based System
- A Major Improvement of the FAA Communications System Will Be Implemented
- ILS Will Be Supplemented by, and Then Replaced by MLS
- Work Must Continue on Improvement of Airports and on Achievement of Higher Airport Capacity
- FAA Will Proceed with Consolidation of Facilities to Achieve Productivity Improvements and Realize System Efficiencies
- Automatic Weather Observation Systems Will Replace Manual Observers
- Direct Pilot Access Will Be Implemented

The Major System Decisions

AUTOMATION

- A Common Computer System for Both Terminal and En Route Applications Will Be Procured
- FAA Will Proceed with Upgrading of Arts II and Arts III
- The Automated Flight Service Station System Will Be Implemented. Major Improvements in Weather Services to Users Will Be Provided
- The Highest Practical Level of ATC Automation with An Integrated Flow Management Process Will Be Implemented

SLIDE 34

The Major System Decisions

SURVEILLANCE AND SEPARATION

- TCAS Will Be An Independent System
- Mode S With Data Link Will Replace the ATC Radar Beacon System
- En Route Primary Radar Will Be Phased Out in 2000. Terminal Primary Radar with a Weather Channel Will Be Continued
- A New Weather Radar System Will Be Provided to Complement Terminal Radar Weather Channel. Probably NEXRAD
- An Automatic Traffic Advisory Service May Be Developed for Limited Terminal Application

User Implications

BENEFITS

- Increased Safety Through Collision Avoidance and Improved Weather Information
- Reduced Delays
- Reduced Fuel Consumption
- Proliferation of Point-to-Point Navigation
- No Additional Equippage Required for Most New Services

SERVICES REQUIRING NEW EQUIPPAGE:

- Airborne Collision Avoidance (TCAS)
- Mode S Data Link
- Microwave Landing System (MLS)
- 25 KHz Communications

Note: The FAA believes that users will assume the major share of capital investment because they are the principal beneficiaries of this plan.

Secretary of Defense, to try to identify those areas. Those we want to exclude. But other than that, no, we will not be taking on any of their functions, nor will they be taking on any of ours.

Mr. GLICKMAN. OK, I am going to stop for now, and I will come back, but Mr. Dunn has some questions.

Mr. DUNN. Thank you, Mr. Chairman.

Mr. Helms, I apologize for being late. I was testifying in front of another committee, which is an unusual experience for me, by the way.

The members of the committee were at your briefing in December. I was very much impressed with the way that you had taken hold of the entire picture and developed a program that answers the relative questions. You took a different approach, I believe, than past administrators who have said, "This is the equipment we have, and how can we make it solve the problem." You started and said, "This is the problem, and how can we implement in the big scope." So I highly approve of your direction.

Nevertheless, I am concerned. You talked about backing up from 1990 down to a scenario of 1981 where we are already behind in the one example the chairman mentioned. You talked about machines that go out for 30 days, and you need a machine that goes out for 30 seconds in a year period.

Just how far down the road are we in terms of sitting down with potential manufacturers and beginning to design programs for them, which is the next step of your program? Has this been started with these companies?

Mr. HELMS. Yes. In generating the overall system plan, as we identified each subsystem, to check on ourselves, I had meetings myself with outside firms. I am in no way saying that the FAA people that were there could not have done it, but I wanted to satisfy myself. I spent an entire day, for example, at the Bell long lines facility to examine what was going to be available over the next quarter century in communications, to see whether they were going to be competitive. I visited numerous facilities.

In each of these cases, we would have the people come in and talk with us, give us their appraisal of what could be done. Because of my emphasis, I cannot afford technological risks. We cannot afford failure. It must work.

I am absolutely satisfied that the things we are talking about can be done. For example, in the case of the computer, if we bought one large, big black box, we cannot do that because it might fail, so we have to buy a second one. Now, then, the first one has to occasionally be put down for maintenance, which says, if it is down for maintenance and the second one fails, we are right back where we started, so we have to buy a third one.

So, instead of doing that, if we go to distributed architecture, where we buy six of these, perhaps, or eight, depending on the processing requirements, tie them together; we can put one down for maintenance, or two, and have another one fail, and we still have adequate capability, and we will offload these into the sector suites so that the individual controller will have the capability at his location to be able to process his ongoing traffic. That is the way we will achieve the reliability we need.

Mr. **Dunn**. What I am getting at is, do you have a date in mind where the preliminary portion of bidding on this new equipment, the preliminary spec sheets, will be out to these companies? Do we have a date yet?

Mr. **Helms**. Yes, sir. We expect to have the specification completed in July of this year, plus or minus 30 days—I would say maybe it could slip to as late as August—and we would hope to go out on the street with the RFP for competition early this fall. It is that well defined.

Mr. **Dunn**. And how many companies will be involved in that?

Mr. **Helms**. I don't know, Mr. Dunn. I have had a number of people come in to see me. They are each still evaluating it. It will be a competitive procurement, however.

There will actually be two approaches or two competitions. One will be for the computer itself, to our specification. There will be a second competition for the systems integrator that will take that computer and then be responsible for the software and the sector suites and integrate them. By doing this, then, we hope to take advantage of the best unique capabilities of both segments of the industry, one portion which specializes in computers and one in systems integration.

I do not believe the FAA has the capability, the management capability in-house, to manage such a large technical program, so we are going to use a systems contractor.

Mr. **Dunn**. From that July 1 or that July 30 date, how long will the companies be given to get their proposals back to you?

Mr. **Helms**. We are still looking at different procurement strategies. For example, we have to conform with A-109. A-109 gives us considerable flexibility, of course. The question is, do we go out to industry and select three for detailed—say, perhaps, 1-year—studies to demonstrate the software or compatibility and then have cost competition among all three, or do we go out for five and narrow it down to two? We have not formally defined our procurement strategy yet, and we will do this as we get a better indication of how many bidders are going to come onstream.

Mr. **Dunn**. I assume that decision will have to be made before this July date that you meet with the companies, then.

Mr. **Helms**. It would have to be made well before we laid out the final phases of the acquisition plan. It would not have to be done before we wrote the spec, because the spec which we have is the spec we want irrespective of the procurement strategy.

Mr. **Dunn**. One more question not directly related to what we have been talking about, but if I might, the President, in part of his austerity move, announced nationwide furloughing of Federal employees. Air traffic controllers were excluded from that 12-day period, I believe it is, for this year. Nevertheless, flight service people—and you talked about them a moment ago—were included in that.

I have got some concerns in that because flight service is where each and every flight originates. Were you involved in that decisionmaking? Did you make that decision? Did OMB make that decision?

Mr. **Helms**. I made the decision as to the 12 days, and I made the decision as to whom it would apply to. But I should back up and furnish Mr. Dunn a little bit more information.

The OPM regulations require that we establish, in advance, the total number of days, with a minimum of 30-day notice, of anyone that is going to be furloughed. Therefore, under those regulations, we had to establish the potential of 12 days. We do not believe the people will be furloughed 12 days. But under the regulations, we had to identify that. My best estimate now is it will be about 6 days; it could be as high as 8.

Second, the reason that I did that is that, assuming that the Congress approves the plan which I have submitted, and looking to 1983, we will have sufficient funding to carry all of our people that we can hold now in 1982 clear through 1983, so that we will not have to have a further degradation in flight service station specialists while we are transitioning into the new automated flight service station.

Without the furloughs, it meant that we would have had to drop off over 600 people. Invariably, when we drop off people, there are always minorities and women at the bottom, and I wanted to keep the entire cadre of people from this point on through into the 1983 year starting on October 1.

So I made the decision for the furloughs. I did it to save jobs. I have no choice.

Mr. **Dunn**. So your best estimate right now is that we are looking at 6 to 8 days, though?

Mr. **Helms**. Six days. It could be as high as 8. I am 99 percent confident it will not be 12, Mr. Dunn.

Mr. **Dunn**. What about the—obviously, your answer will be that there is no impact on it—but the impact on safety? Like I say, there is a lot of overlapping between the service provided by flight service and the air traffic controllers as we plan our flights. I assume you took that into account.

Mr. **Helms**. Well, I would not support anything which I thought degraded safety.

You will note that, despite the fact that we have all known that we had a major problem with the budget since September or October, I would not consider this until we were basically through the winter months. So this will not become effective until April 1. That was the major thing that had me concerned.

Second, we have a rather wide diversity. For example, we have some flight service station specialists that will handle no more than 3,000 inquiries a year. We have some others that will handle 26,000 a year. Well, I am looking to raise that average up to the point—because that is efficiency, and that is what some of this new equipment will do.

I really would strongly oppose any reductions or furloughs or otherwise if I felt that this could directly relate back to safety. I do not, and that is the reason I delayed any action until April. I think we will be then into the spring and summer weather, and the major weather, this being the worst winter I guess we have had this century, will be behind us.

Mr. **Dunn**. I will second that.

Thank you, sir.

Mr. GLICKMAN. Mr. Hall?

Mr. HALL. Mr. Helms, I apologize also for my lateness in arriving. Perhaps you have already covered this, but say I am an owner of a small 310. How am I to be affected by this costwise? If you have already covered that, just tell me and I will seek it out of the record.

Mr. HELMS. Well, I have covered it, but it would be, in the case of that type aircraft, which uses aviation gasoline, the tax on it would be increased, and it would be 12 cents a gallon, assuming that the Congress approves this tax plan, and it would be increased 2 cents a year after that.

That is equivalent to the 1970 tax increase of slightly over half on the per-gallon cost basis. But it would be 12 cents a gallon, Mr. Hall.

Mr. HALL. Any capital changes?

Mr. HELMS. In your aircraft?

Mr. HALL. Materialwise?

Mr. HELMS. You would need none immediately. Eventually, you would have to have an MLS receiver, and that would come about, in sufficient quantity, by about 1993 to 1995. To get full utilization of the system, I do not think there would be enough ILS installations left.

Our problem is that, for example, we have an ILS system operating that was installed in 1943 in Bangor, Maine. We have NDB beacons that are operating, one in Texas that was commissioned in 1937. These things are just costing us a fortune to maintain.

In your aircraft, to use the new MLS, you would eventually have to have that receiver. If you wished to fly into a terminal control area, as of now, you would have to have an encoding altimeter and you would have to maintain that. The TCAS system is directly compatible with that encoding altimeter right now, so you would not have to change that.

By 1991, I would expect you would probably have to go to an encoding altimeter as opposed to just a transponder, also. Other equipment, if you elected to not do so, you would not have to do it. A flying farmer, for example, most people do not realize it today, does not even have to have lights on his aircraft. He does not have to have a radio. So if he elected to stay out and fly in that area, he would have to have nothing.

Mr. HALL. Thank you very much.

Thank you, Mr. Chairman.

Mr. GLICKMAN. Mr. Helms, let me ask you a couple of follow-up questions. One is that, with regard to the costs of this system and the tax structure and the components of the 5-year funding plans for both the R. & D. and the F. & E., we are going to get you a letter which indicates basically what we want, what information we want back from you. We are going to get you that by tomorrow if possible. (See Appendix.)

Mr. HELMS. Very good, sir.

Mr. GLICKMAN. You said that in a couple of weeks, you would have some detailed——

Mr. HELMS. I am confident that we can get it to you within a couple of weeks. I think so, Mr. Chairman.

Mr. **Glickman**. It may be something that you may want to address to a multiple number of committees so you do not have to write more than one letter in the process.

Mr. **Helms**. I have had a similar request from another chairman of another committee, yes, sir.

Mr. **Glickman**. OK.

My second question relates to the number of employees. If in fact your plan proceeds as you wish it will, what will the ultimate effect be on, A, the number of air traffic controllers as compared to now, B, the number of flight service station operators, and C, any other FAA employee?

Mr. **Helms**. We projected the present state-of-the-art and assumed that we did no technology improvement but rather maintained what we had. With the projections and the increase in population of aircraft, the number of air traffic controllers would go to 28,800. With the system which we have proposed, with it in automation, it in fact will go down to 9,500. The 9,500 will be able to handle over 100 percent more traffic with a significant increase in efficiency.

In the case of flight service station specialists——

Mr. **Glickman**. So if we did not automate or do what you are talking about, we would have approximately 28,000 controllers?

Mr. **Helms**. Yes, sir.

Mr. **Glickman**. What do we have now in the system? Of course, you are rebuilding to some degree.

Mr. **Helms**. Yes. We have about 9,500, but that includes a number of supervisors. We have about 9,500 people actually——

Mr. **Glickman**. What did we have before the labor dispute last summer?

Mr. **Helms**. 17,300.

Mr. **Glickman**. So what you are saying is, if you did not automate, you would have to go up to a 28,000 number, approximately?

Mr. **Helms**. Yes, sir. That is correct. With the automation, we can do the job with about 9,500. Much more important is that the controller will no longer have to make that judgment as to whether to turn or when to have them go down or up.

One of the slides I showed—and we have demonstrated this with one of our contractors working on the program, and we have had numerous of our controllers now—I have been very active in getting people who are working the job to come in and start to review this and get their ideas in. Now we will be able to have automatic descent, climbout, conflict avoidance, direct instructions so that the controller will become more and more of an executive agent, if you will.

In the case of the flight service station specialists, we would go down probably in the neighborhood of 3,000 people. However, we will still have to hire them because, before we get there, our retirements will offset it.

Mr. **Glickman**. 3,000? Where are you now in flight service station personnel, approximately?

Mr. **Helms**. We are at about 4,600 now, and we would go down, I think, about 1,800. We are talking about going down over a 10-year period.

Mr. **Glickman**. OK. Will any other FAA employees be affected?

Mr. **Helms**. Yes. The maintenance technicians would also go down. There again, however, we would still have to hire people because they will be retiring at a greater rate than we would have them ordinarily reduce. So we do not foresee a manpower or an employment problem, Mr. Chairman.

Mr. **Glickman**. What commitments have either the President or Mr. Stockman given you regarding your plan?

Mr. **Helms**. Well, of course, the President's budget for 1983 included recognition to the tune of a significant increase for the first year at $725 million. That was my request, and it was not lowered. There has been no request after that.

The President, as part of his preelection campaign, noted the need for and support of modernizing the Nation's airways, and I feel this administration will be firmly behind the program once there is agreement reached with the Congress, and there is no question in my mind that they are firmly behind this program.

Mr. Stockman's organization has indicated in general that, to the extent we raise revenue, he would have no objection to it being expended for modernizing. He recognizes it needs to be done, also. But he is not willing to commit to the program without there being a corresponding congressional commitment to raise the revenue, and that is understandable, I think, on both parts.

Mr. **Glickman**. To some extent, I think this administration has been afflicted by a noncompromising attitude in other areas. I am not asking you to agree or disagree with me; this is my value judgment. I am hopeful that the recognition can be made that in the area of both an ADAP bill which would authorize the expenditures and in the area of a tax bill to raise the money that there needs to be a consensus here and compromise reached with Members of Congress of both parties. Otherwise, we may end up with nothing and stalemate, and the plan does not go through, and revenues are not raised, and the airway system in this country deteriorates even further.

I know that you are committed very strongly to this plan, but I would just encourage you to take that message back to the Office of Management and Budget that unless there is some feeling about the interests of the legislative body in this process, we are going to be stalemated like we have been for the last 3 or 4 years.

Mr. **Helms**. I will do so, Mr. Chairman, and I recognize both the intent and the interest that the chairman has, also, because of the obvious overwhelming need for aviation safety in the future. We are rapidly running out of time.

Mr. **Glickman**. One side issue I had not mentioned before. You talked about getting input from users. Are you trying to get some formalized input from the controllers themselves, your operating personnel, into this plan? Have you been doing that, and do you plan to continue doing that?

Mr. **Helms**. I have been doing so and I intend to continue. We have had three different approaches, mockups, displays, things which we have been trying regarding sector suites, the equipment the controller comes face to face with. We have one that will be delivered to our technical center in Atlantic City probably late this month or early next month.

In each of those cases, we are taking working-level controllers over to evaluate it, and they are making darn good suggestions. So what we will do is, bring a group in, log very carefully their individual recommendations, and then bring another group in after we put those in. We usually have two groups on one configuration to make sure that there is not an osmosis factor; that is, that both of them generally feel it ought to be changed.

Then we will make changes and have another group come in. So it is an iterative process to take advantage of those people who are actually doing the work. The response has been very positive, I might add.

Mr. GLICKMAN. I want to go back to a point that Mr. Dunn raised for a moment because it concerns me a little bit, and that is, with budget cuts on the area of aviation safety. Now you indicated that you did not make any judgments or decisions on reducing of personnel levels until after the winter months were over, implying, of course, that they were needed in greater numbers during bad winter weather.

What concerns me is that weather can be bad during summer months, too, in different locations in this country. I am thinking about the severe thunderstorms that develop all over America, but particularly in the South and in the Midwest, and whether we might conceivably have some problems develop with the reduction in force, particularly as you are trying to make a transition or are beginning a transition here on capital expenditures. I wonder if you might comment on that.

Mr. HELMS. Yes. In fact, one of the things which the American public, of course, does not like is bad weather, but the Thanksgiving weekend, first, was one of the best things that happened to the FAA because the entire Eastern part of the United States—that is, east of the Mississippi River—except for a band through Florida, was covered by a low cloud deck that had freezing rain, drizzle, and, in some areas, ice. It gave us our first test, if you will, of whether we could handle it.

We had another period in December which gave us 5 days in a row. Oddly enough, we had a period in the first part of January in which all of the United States except southern California, Arizona, and the tip of Florida were covered by a cloud deck, and that was the time we had some 8 inches of snow in Minneapolis, et cetera.

The reason I mentioned that is that, during the winter months, we have larger areas that are covered, and that is when the pilot gets in bad trouble, whereas, with a thunderstorm, most of them rarely last more than 30 minutes unless it is a line squall—I will address that separately —which says, then, that he can either fly around it or he can wait 20 minutes or 30 minutes and still have a fairly decent landing set of conditions.

Now the question comes up, what does he encounter if he has a line squall? But those are very predictable now. Those are the things that can be tracked on radar. So the total exposure to the pilot, then, of these types of things in the summer is going to be significantly reduced as compared to running into ice in the winter time—that is, ice on the aircraft—fog, low ceilings, that sort of thing. That is the reason I am not as concerned about it in the summer.

Mr. Glickman. Mr. Dunn had another question.

Mr. Dunn. I am glad you are no longer concerned about thunderstorms.

One question, and I do not want to open up the whole area of Air Florida's accident but nevertheless, one of the factors in that mishap might possibly be the condition of the runway at the time that the airplane left the ground, and I had a similar experience going back into my district this weekend, in which neither ADIS nor approach control told me about ice on the first 500 feet of the runway, and it was a day with drizzling rain and we did some sliding before we finally came to a stop.

We have got all kinds of equipment that measures the air conditions above the runway, but are we doing any work on the actual conditions of the runway, either in terms of slush buildup—and I realize these vary from one minute to the next—some sort of equipment to tell us when we have reached a critical stage with slush—and I realize that critical stage is different from a small twin to a 747—or either the factor of ice on the runway? Are we doing anything like that in the future? I am talking about the actual conditions of the pavement; I am not talking about the air above it.

Mr. Helms. Yes, sir. Let me distinguish the element of grooving in the pavement. That really takes care of the water and not the problem that you are talking about. Others have raised the question.

Recognizing that there is a potential problem, we have an FAA regulation out that says that you will not take off if there is over half an inch of slush on the runway because of the fact that it is unpredictable, just as you note. In fact, if there is no salt, which there rarely is on those types of runways, if it is liquid, then splattering that up can cause freezing on the aircraft at places you did not anticipate. So that is one of the major reasons we have the requirement for no more than half an inch.

As regards our ability to measure that, we cannot find a way to do it. We have no sensors that will predict or will show ice at one point as compared to another. Primarily, it is because, if you scrape it with a plow, you cannot scrape it within a quarter inch and measure it that way on a consistent basis.

So, although I do not like it, we have not yet been able to find a sensor combination that will do it. All we can do is establish the combination of rainfall and temperature which indicates the probability of it, or we can go out and measure it.

At some airports, for example, JFK—this will sound odd to you, Mr. Dunn, but it actually works—we have bird scare operations. That is, we send crews out to scare the birds off and keep them away from the runways. This is particularly true of airports near dumps or near coastlines where there are a lot of gulls. We can use them at times to give us reports on the runways. But as far as a sensor device or something to automatically tell us about the ice on the runway, we have not been able to uncover one.

Mr. Dunn. The other factor that might be able to play in there, and as a developer, I have used it in the past, are heat tapes. I have used it for ramps for commercial buildings in Michigan where we cannot have ice on those ramps for cars going up them. I have got them in my own driveway, and they really work. I realize they are terribly expensive, both to put into concrete or blacktop and also to maintain, but nevertheless, they do the job.

Have we ever explored the cost impact for, say, the first 1,000 feet of a runway on that type of thing?

Mr. **Helms**. I am not aware of it if we have. Mr. Albrecht, who has been here for many years, says no, that we have not, and if for no other reason than to give myself some education, I am going to take a look at it and see what the costs may be.

Mr. **Dunn**. The heat tapes are something that we have used in developing for about 5 years now, and they do the job.

Mr. **Helms**. Yes, they do. We will look into it. I would like to know, myself.

Mr. **Dunn**. Thank you, sir.

Mr. **Glickman**. Let me just call up a couple of quick questions. With regard to the frequency of authorization of your programs by this committee and other committees, how can we best achieve our sometimes contradictory objectives of maintaining flexibility for program changes through the annual authorization process and of assuring program stability?

Mr. **Helms**. It would appear that, for a program of this magnitude and what we are trying to do, that a 5-year authorization would be a proper way to go, but with the caveat that it must be reaffirmed each year by this committee, both to satisfy itself that the appropriate technology was in fact being implemented, the schedule and the program were being accomplished.

But I find it, as a systems engineer, very difficult to say that on an annual basis something of this magnitude that you have to sit down and authorize each element again, it is going to be difficult to do it, Mr. Chairman.

Mr. **Glickman**. So what would be the most useful process for you? I mean, a long-term authorization with some sort of annual oversight in which we would have the opportunity to redirect you if something tremendous has gone amiss, I assume? We have got to have that control in this body since we are funding it, basically.

Mr. **Helms**. Yes, sir. I would think that a 5-year authorization, but with the clear-cut recognition that, every year, we are going to have to come back again and reaffirm it; adequate oversight; that would probably be the best way because it does two or three things. It allows us to make longer term plans; it becomes evident to the total aviation community that the Congress is serious about it. But one of the major items is, it allows us to take a posture in the international community which could be very significant.

I am most concerned about the fact that so many of the aviation products in the United States are no longer being sold overseas. Once there is a program laid out such as we are talking about here so that the overseas customers now start to see a long-term program, I am hopeful that we are going to see a lot of U.S. manufacturers start to sell this equipment around the world and make a much greater contribution to the trade balance.

Mr. **Glickman**. That is an interesting comment. What you are almost saying is not only will the equipment be sold overseas but the fact of the matter is, if they see us develop a modernized air system in this country, perhaps it may have spinoff effects on our entire aviation industry.

Mr. HELMS. Yes, I think so, Mr. Chairman. That was specifically the point I had in mind. I have already started exploring this with some foreign countries, and I will be making a trip in March with this in mind. I believe that we have to reaffirm this Nation's leadership in aviation.

There was a time when 90 to 95 percent of the aviation products in the world came out of the United States. Today, 32 percent of the wide bodies do not. I think the country has got to step up to it, or we are going to transfer our jobs overseas.

Mr. GLICKMAN. Yes.

Mr. HELMS. In the case of the National Airspace System Plan, I would like to see those jobs remain here in the United States.

Mr. GLICKMAN. A final question. The plan itself identifies geographical locations that have the FAA facilities identified for closing. There has been a lot of concern by people. Are these dots in concrete on the maps? I wonder if you might address that question. Also, what is the connection between those specific locations and the total system plan?

Mr. HELMS. Well, first, the closings did not come about as a result of the plan. There is no direct connection of any kind. Rather, the plan was folded around the recognition that we no longer need all of those. It was a reverse process, if you will.

The state-of-the-art in communications today and in remoting, both for communications, radar data, is such that we no longer need, for example, the 22 to 25 centers that were originally laid out in 1960. So even if this plan is completely turned down by the Congress, we will still be combining centers and other operations.

Second, the identification of those in the book is not a firm conclusion at all. Rather, in an effort to identify what I needed in the way of total switching systems, I had to select various ones.

For example, you need a center which has strong international, very strong local, and multiple airport capability; hence, it shows the New York center. I assure you, there has been no decision to close the New York center. But the major portion of international traffic came across the North Atlantic; it is a concentrated segment.

We needed another area inside, so basically, what I am saying is, there is no connection whatsoever about the geographic location and the content of the plan. Those would be combined in any event.

As regards the flight service station closings and combinations, this was first presented to the Congress in 1980. The Congress funded it. Again in 1981, the FAA identified candidate sites which would be closed. Three or four of those have already been announced, and this will continue this year. We will be combining those into the automated flight service station program.

In summary, there is no connection between the system plan and any geographic location.

Mr. GLICKMAN. Let me ask you another question. First of all, I might mention that—Mr. Dunn mentioned some questions about icing and related things—this subcommittee, together with the oversight subcommittee, is going to hold hearings next month on air safety, and you will be called to testify, or your agency will, in terms of things like icing, human factors, the state-of-the-art; what are we doing in that area?

Mr. **Helms**. We will try to get at least a first-cut cost-benefit analysis for Mr. Dunn, then, on his question of, say, the first 1,000 feet, and let us see what it would cost us and how we would do it and that sort of thing. We will try our best.

Mr. **Glickman**. OK. He wants to add something.

Mr. **Dunn**. Where we have used these heat tapes, it might be pointed out that we have cut down in our maintenance, because if you turn them on when it starts to rain or snow, it never builds up, and we use them in 36-inch-wide strips, so the cars can use it even if snow builds up between it or on the sides. You can still have traffic flowing, so you actually save some on maintenance because of plowing.

Mr. **Helms**. I am familiar with them, Mr. Dunn.

Mr. **Dunn**. OK.

Mr. **Helms**. I have seen them in industrial applications.

Mr. **Dunn**. Whether they would work and how wide the strips would have to be for a runway, I do not know.

Mr. **Glickman**. Anyway, we want to pursue a variety of issues regarding air safety in America, and that is something that we would want to pursue.

The last thing I wanted to ask you before we let you go is that there has been quite a bit of publicity lately about your making some public statements about noise and the use of the Nation's airports. I wonder if you might want to comment on that issue.

Mr. **Helms**. I think I have to harken back to, I believe it was Mr. Dirksen, but I am not sure, but whoever it was made the statement that the administration proposes and the Congress disposes. I believe that the Nation can no longer put off this question, are we going to have airports or not? The reason is not because I like it or dislike it. This question will be here long after I am gone. But, fundamentally, if we project the growth in aviation with any degree of validity, it clearly shows that we dare not let any of the existing airports go out of business, or we are going to have large-scale layoffs or lack of growth.

Therefore, if we are going to keep airports open, it is time that we face up to it. So we at FAA started drafting some legislation, which we do have in draft now, with a view toward letting properly the Congress make that determination: do we in fact, as a nation, confirm that 1 or 2 percent of the people—actually, our data shows about 0.7 percent—live close to airports and are affected by noise, and that will govern the Nation's economic growth as regards transportation; or do we say the other 97 to 98 percent of people who may not use it but need the option should in fact have the final decision?

I am concerned about the closing of airports, and I think it is time we stepped up to it. I think that we have to make a decision and that it should be a joint administration and congressional decision, and we intend to press to keep these airports open.

JFK is the largest employer on Long Island. Most people do not realize that. They think an industry, but they do not realize the magnitude in economic contribution an airport makes. Wages alone that are generated out of JFK are over $400 million a year. There is over $3 billion in trade with attendant taxes to the local community that comes out of that one airport.

So we are talking in terms of very dramatic contributions to local economy. What I want is to have these communities make the decision now, do you want to keep jobs and the economic development, or do you want to shut the airports down? We cannot have both. I must say, there are very few people in the Government that feel more strongly than I do about deregulation and getting the Federal Government out of it, but at the same time, we do have a Federal responsibility to the total citizenry.

This is one of those cases that I do not like. I would far prefer that the local community come up with its own noise program and one that can be compatible. But I am most concerned that we have the requirement to generate jobs for the next generation, also, and transportation is a key provider of those jobs, and that is the thrust of what I am after, Mr. Chairman.

Mr. GLICKMAN. You mentioned Senator Dirksen. He also said, "I am a man of principle, and my first principle is flexibility." [Laughter.]

Apparently, you are a believer of everything Senator Dirksen said.

I have no other questions. If nobody else does here, we appreciate your testimony, and we will look forward to tomorrow afternoon, where the agency will testify on both this and other program activities. I think Mr. Albrecht will be here testifying.

Mr. HELMS. Yes, sir.

Mr. GLICKMAN. Thank you very much.

Mr. HELMS. Thank you, Mr. Chairman.

[Whereupon, at 11:44 a.m., the subcommittee recessed, to reconvene on Wednesday, February 24, 1982, at 2 p.m.]

1983 FAA R. & D. AUTHORIZATION

WEDNESDAY, FEBRUARY 24, 1982

House of Representatives,
Committee on Science and Technology,
Subcommittee on Transportation,
Aviation and Materials,
Washington, D.C.

The subcommittee met at 2:03 p.m., in room 2318, Rayburn House Office Building, Hon. Dan Glickman (chairman of the subcommittee) presiding.

Present: Representatives Glickman, Dunn and Hollenbeck.

Mr. Glickman. The subcommittee will be in order.

Today, the subcommittee will conclude the first phase of its hearings on the FAA's National Airspace System Plan and the request for fiscal 83 Research, Engineering, and Development funds to begin that plan.

Yesterday, we heard what I consider to be an excellent overview from the Administrator of the FAA, Lynn Helms. Today we will examine in greater detail the first year R. & D. requirements of that plan.

Later on, on April 28 and 29, we will ask for testimony from interested user groups and others who may be affected. By then, we should have the full details of the administration's proposal for extension of the airport development aid program, as well as the ideas from the administration on how they intend to seek the revenues for the operation of that plan, because without both of those particular aspects of it, the plan makes interesting reading, but that is about it.

At that point, we will be ready to mark up and report our portion of this year's ADAP bill.

Al Albrecht is here, the Associate Administrator of the FAA. I would suggest, Al, that you go ahead. Since the House is not in session, to speak of, I am not sure how many additional members we will have, but there may be some who walk in as time goes on. You may proceed as you deem appropriate.

I notice that you have a shortened version here which is about 70 pages long. I don't know how long the long version is.

Mr. Albrecht. I thought I would spare you the full version, Mr. Chairman.

Mr. Glickman. OK, very good. Go ahead and proceed.

Mr. Albrecht. All right, thank you.

STATEMENT OF AL ALBRECHT, ASSOCIATE ADMINISTRATOR, ENGINEERING AND DEVELOPMENT, FEDERAL AVIATION ADMINISTRATION, ACCOMPANIED BY NEAL A. BLAKE, DEPUTY ASSOCIATE ADMINISTRATOR FOR ENGINEERING AND DEVELOPMENT, AND VALERIO R. HUNT, DIRECTOR, ADVANCED AUTOMATION PROGRAM OFFICE

Mr. **Albrecht**. Good afternoon Mr. Chairman and Members of the Subcommittee. I am Al Albrecht, the Associate Administrator for Engineering and Development. I have at the table with me Mr. Neal Blake, my Deputy, and for expert backup I have sitting behind me Dr. Ed Koenke, Director of the FAA Technical Center; Mr. Val Hunt, Director of the Advanced Automation Program Office; Mr. Bob Wedan, Director of the Systems Research and Development Service; and Mr. Marty Pozesky, Deputy Director of the Systems Research and Development Service.

Yesterday, Mr. Helms briefed you on the National Airspace System Plan (the NAS Plan)—our agency wide effort to chart a comprehensive plan for modernizing and improving the air traffic control and airway facilities systems from now to the year 2000. This NAS Plan describes the research, development and engineering necessary to support FAA's modernization and improvement efforts for ATC services, flight services, weather services, and navigation facilities. Because the NAS plan only describes those research activities which directly support F. & E. modernization activities, (Viewgraph 1), I have directed the preparation of a "Companion" document, which also includes the additional research and development activities required to support aircraft safety and aviation security, investigation of advanced concepts and application of advanced technology, airports research and development, and aviation medicine.

Mr. **Glickman**. When you say that fiscal 1983 amendment of $23.5 million, you mean an add-on over what the administration originally recommended, then?

Mr. **Albrecht**. It is in the President's budget proposal.

Mr. **Glickman**. Oh, add on to the budget item——

Mr. **Albrecht**. Yes, right.

Mr. **Glickman** [continuing]. Because, of course, we have not appropriated the 1983 budget.

Mr. **Albrecht**. Yes, right.

Mr. **Glickman**. OK.

In preparing the new R. & D. plan and supporting budget requests, priority has been placed on those items supporting the NAS plan. This includes improvement of en route facilities, terminal facilities, flight service stations (that is, FSS's), ground-to-air systems, and interfacility communications. Today, I will describe the status of our engineering and development activities, with particular attention to those which directly support the NAS plan. Many of the fiscal year 1982 milestones in my testimony are contingent on FAA's receiving a fiscal year 1982 supplemental appropriation of $16 million. Our proposed accomplishments in fiscal year 1983 are dependent on receiving the fiscal year 1982 supplemental and a $23.5 million fiscal year 1983 amendment proposed for later transmittal. These two amendments will have to be justified separately to Congress. (Viewgraph 2.)

The remainder of my presentation will cover several of the programs shown on this viewgraph, which represent our major engineering and development areas. If there is interest in going into depth on any of the other progams, I am prepared to do so. (Viewgraph 3.)

A major part of the new system will be a modernized ATC computer system. The purpose is to provide needed computer capacity and to improve the reliability of the present en route system computers by the mid-1980's. This computer system will also serve as the core of the future automation system which will include new software and a new system architecture which will be designed to provide the additional reliability and flexibility needed to accommodate higher levels of automation. The technology is currently available for FAA to undertake this major modernization effort using state-of-the-art equipment. The system design activity, however, will require a major upgrading of our software to accommodate future requirements for ATC automation services. Both en route and terminal functions will be merged into a common software-hardware system. (Viewgraph 4.)

The computer modernization program will be broken down into phases. The first step of system development will be replacement of the existing en route computers with new modern state-of-the-art technology systems using the current displays and rehosting the en route system software. A second and concurrent step will be the design of a new automation system which will utilize the computers procured in step 1 combined with development and implementation of modern controller sector suites along with new system software. These system elements will be configured in a new system architecture designed for high reliability and providing the capability to facilitate the implementation of the future automated en route air traffic control system functions (called AERA) as they are developed.

The initial AERA capabilities of direct route planning and improved flow management will be included in the new software. In step 3, the higher levels of automation being developed under the AERA program will be added to the system. (Viewgraph 5.)

The present en route computers will be replaced with new computers which can rehost the existing en route system software and interface with the current display channel systems. The rehosting phase of the program involves rehosting the 9020 NAS monitor and the 9020 ATC applications software as the first step toward achieving a common advanced ATC automation system for en route centers, consolidated hubs, and offshore centers. The NAS software is one of the largest, most complex, software packages ever written, and this effort will be a major undertaking. We expect to issue the RFP or the request for proposal for the new hardware this summer and to award the contract in the summer of 1983. (Viewgraph 6.)

The second major element of the advanced computer system is the development of a new sector suite, development of new system architecture, and redesign of the current system software which will utilize the new host hardware. The new sector suites are intended to support the consolidation of centers and approach control facilities. It is also expected that this consolidation can be accommodated utilizing common hardware and software systems. The new sector suite is intended to support both the en route and terminal ATC functions. Software functions that are now unique to terminal ATC systems will be incorporated into the new software so that it can support the consolidation of TRACONS into centers and terminal hubs. The experience derived from both the electronic tabular display system [ETABS] and terminal information display system [TIDS] programs will be incorporated into the sector suite design. It is also envisioned that common equipment will be utilized for offshore and en route applications.

The request for proposals for the sector suites, design of the new system architecture, and redesign of the current system software will also be available next summer. Contract award for two parallel contracts will be made in the summer of 1983. (Viewgraph 7.)

Mr. DUNN. Does that mean that we will go directly from traffic controller to tower?

Mr. ALBRECHT. I am sorry, Mr. Dunn.

Mr. DUNN. Does that mean, under No. 1 of your chart, we would go directly from en route control, switch over the tower and eliminate approach control completely? Is that what that envisions?

Mr. BLAKE. No. The function would be retained. In some cases, the approach/departure control function would be performed at consoles physically located in the traffic control center and in some cases would be in a consolidated terminal hub, which is somewhat similar to an expanded New York common IFR, for example.

The objective of the AERA program is to attain the highest practical level of ATC automation, allowing computers to do as much of the routine work as possible thereby increasing the productivity of supervisors and controllers.

Early functions of the AERA will be provided with new system software, with increasing automation levels provided in future enhancements.

The work we have done on automation of the ATC process itself in the AERA development has convinced us that we can provide high levels of automation which will produce major improvements in the efficiency and productivity of the system. We can no longer afford to shrink the size and increase the number of ATC sectors to accommodate traffic. Automation can make our system less manpower-intensive, while at the same time procucing major efficiencies.

The AERA program will rely upon the availability of improved voice and data communications and the availability of mode S data link to achieve these significant productivity savings.

Early functions of AERA will be called out as a part of the step 2 procurement to provide automation tools to aid the controller in preparing and issuing fuel efficient clearances and direct routing. Step 3 functions will perform the more complex functions such as automatic conflict probe and resolution to free the controllers of the workload of the critical detection and resolution of conflicts.

During 1982, the full AERA data processing requirements will be identified as an input to the en route host specification. Preparation of the specification for AERA package 1 will be completed in 1982. In fiscal year 1983, we will continue the man machine experiments at the FAA Technical Center. The initial functions of AERA will be available with the installation of the new computers starting in the 1989 time frame. AERA package 2 functions will be developed by 1984, and implementation is planned for 1992. (Viewgraph 8.)

Modernization of our high activity FSS' is one of the most needed programs currently being undertaken by FAA. Demand for flight services is expected to increase by 79 percent between now and 1993, and a major increase in staffing and funding levels would be necessary to meet this demand if automation efforts were not completed.

Last year we entered into a contract to automate 61 of our largest FSS's using F. & E. funding. Parallel R. & D. efforts continue to develop enhancements to that system that will include the voice response system, an expanded direct user-access terminal function, an aviation route forecast function, a mass weather dissemination system, and provisions for weather data transmission via data link. (Viewgraph 9.)

The model I system which will automate weather and aeronautical information and flight plan entry and processing at the major FSS' will be implemented later this year. The model II system which includes the addition of retrievable weather information using an alphanumeric graphics display will be implemented in fiscal year 1986.

Model III efforts include continuation of the voice response demonstrations in Washington, D.C., and Columbus, Ohio, and award of the initial enhancements contract in 1983. Initial enhancements will include voice response system services and the use of direct user access terminals. (Viewgraph 10.)

Concerning FAA's aircraft separation assurance program, conflict alert and conflict resolution will continue to function as the primary system for assisting controllers in reducing system errors.

In addition, the aviation industry and FAA have sought an independent airborne backup to the ground-based ATC system to provide yet another measure of safety to protect against ATC system error and pilot error. The TCAS I and TCAS II systems have been selected to provide this independent protection. I will speak in depth on TCAS in the next few slides.

An automatic traffic advisory service (called ATAS) is being considered for possible implementation at some high-density terminal locations. This service can provide ground derived traffic advisories to equipped aircraft using the mode S data link; enhancing system safety and increasing controller productivity. (Viewgraph 11.)

TCAS equipments will operate throughout the airspace without dependence on ground equipments and will operate compatibly in the current and future ATC system. TCAS also uses the mode S message format to insure future compatibility with the ICAO internationally standardized secondary surveillance radar.

Various levels of collision protection will be available from TCAS equipments. The least expensive TCAS I option, intended for installation in small general aviation aircraft, will provide an alert to the pilot indicating that an intruding aircraft is in the near vicinity. In addition, TCAS I equipment can display the position and maneuver intention of TCAS II aircraft. The more sophisticated TCAS

II unit would be capable of not only providing an alert that an aircraft is nearby but would also indicate the relative position of the intruder by displaying a traffic advisory and coordinated resolution advisory on a cockpit display. The more expensive TCAS II will provide the maximum protection in all airspace. (Viewgraph 12.)

TCAS II is a full-capacity system intended for installation in air transports and sophisticated general aviation aircraft. TCAS II is further distinguished as either the "minimum" TCAS II or the "enhanced" TCAS II. The "minimum" TCAS II can provide: Climb/descend resolution advisories in high density airspace; proximity warning indications of nearby aircraft to include the bearing of the intruding aircraft; crosslink traffic and maneuver advisories to TCAS I equipped aircraft to allow safe maneuvering between TCAS I and TCAS II equipped aircraft; and assurance that signals transmitted by TCAS II avionics do not degrade the ability of the ground-based ATC radars to sense traffic.

Yes, Mr. Dunn?

Mr. DUNN. You know what my question is going to be. What does that last one mean, "Does not degrade the ability of ground-based ATC radars?" My question to you before was, and still is, are the traffic controllers on the ground going to also get the same signal that the small aircraft gets.

Mr. ALBRECHT. On previous occasions, you have asked if we would coordinate between the air and the ground. The answer is, of course we will coordinate between the air and the ground. The exact mechanism for doing this may be by radio, may be by data link; there are various options.

Mr. DUNN. I just really see it as imperative that when this signal is given that I am about to climb or dive, that the traffic controller who is controlling 7 or 20 aircraft gets the same signal at the same time, because he is routing those other airplanes.

To say that I am going to be able to pick up on the radio and tell him that I am performing a maneuver, I do not see as the same thing when we are talking about a matter of seconds. Is it impossible to design equipment that sends the signal and also sends it down to the ground?

Mr. ALBRECHT. The answer is, of course, no, it is not impossible to design equipment, and we intend to include it in the design.

The enhanced TCAS II system will be able to generate right and left turn advisories. (Viewgraph 13.)

TCAS I provides a limited set of traffic advisory services and includes an integral mode S transponder which enhances ground surveillance, and permits a small general aviation aircraft to be seen by a nearby TCAS II aircraft.

TCAS I also has the ability to receive and display the mode S advisories crosslinked by TCAS II equipped aircraft. Finally, TCAS I has the ability to sense the presence of nearby aircraft by passively listening to their transponders' replies. (Viewgraph 14.)

The schedule for TCAS development will result in TCAS I avionics becoming available for installation in 1983 and TCAS II in 1984. (Viewgraph 15.)

The mode S transponder can provide the capability for data link communications to and from the ground. That capability along with the availability of a surveillance data base used by the ATC system permits the development of an automated traffic advisory service (that is, ATAS). Such a service would automate the function now provided by air traffic controllers, calling to pilots' attention information of traffic of concern who may or may not be full participants in the ATC system. This data link application can provide ground-derived traffic advisories primarily in high traffic areas as well as terrain, obstacle, and restricted airspace advisories to equipped aircraft. A draft ATAS national standard will be available later this year. (Viewgraph 16.)

Included in the NAS plan is a program to improve the quality of weather data available to pilots and controllers. The weather program encompasses three major development areas:

(1) development of an improved national system for detecting hazardous weather phenomena through the application of Doppler radar technology (Nexrad); (2) enhancements to the weather data bases of the ATC system to provide pilots and controllers with the capability for rapid access to hazardous and routine weather information; and (3) development of ground-based automated weather observation systems to provide observations at locations where needed; such as, airports with approved instrument approaches, heliports, and offshore drilling platforms.

FAA research activities in these areas are monitored by the Federal Coordinator for Meteorological Services and Supporting Research. This office coordinates the activities of all agencies having weather-related missions and activities, including FAA's aviation weather programs related to aviation safety and the efficient use of airspace. The FAA provides a representative to the Office of the Federal Coordinator who insures comprehensive weather planning on a national level. (Viewgraph 17.)

To provide weather radar services, FAA is working with DOD and DOC to establish an aviation weather radar network that will provide accurate hazardous aviation weather products. A new Doppler weather radar system (Nexrad) will be developed to provide real-time weather data for ATC functions in en route airspace and in some terminal airspace. Should the planned deployment of Nexrad radars not be adequate to meet the high density terminal weather data requirement, FAA may initiate development of a terminal Doppler weather radar to obtain accurate real-time precipitation, turbulence, and wind shear data for the airport/terminal area.

Awards of multiple system design contracts will be made in 1982. Results of this activity will be used in awarding the validation phase contracts in fiscal year 1983. Initial implementation of Nexrad is planned for fiscal year 1987. (Viewgraph 18.)

A Center weather processor will be developed as part of the Center Weather Service meteorological position system to achieve real-time dissemination of hazardous weather information to air traffic controllers, pilots, and flight service specialists at en route sectors, Tracons, tower cabs, and FSS's. This is intended to improve the capability of the system to cope with and advise pilots of hazardous weather conditions. These improvements in the collection and distribution of weather information are needed to reduce the number of weather-related accidents and air traffic delays caused by weather. These efforts are divided into three phases. Phase I activity includes automating the Center Weather Service unit workstation and providing a capability to disseminate weather data to ATC sectors. In fiscal year 1982, we will complete the engineering requirements for the Center weather processor; and in fiscal year 1983, FAA will issue the request for proposals to develop the processor. Implementation of the Center weather processor will be in fiscal year 1985.

Phase II efforts will provide the capability to provide weather contours on the controller's display and this enhancement should be ready for implementation in fiscal year 1985.

Mr. GLICKMAN. Let me stop you for a minute.

Mr. ALBRECHT. Yes, Mr. Chairman?

Mr. GLICKMAN. Weather contours—so that would permit a controller, on the same display as he is looking at to vector his traffic, to delineate thunderstorms and other weather problems?

Mr. ALBRECHT. That is the intent. "Contours" is kind of a generic term to indicate he will have specific weather information that will point out very high turbulent areas, that will point out high precipitation areas.

The product from Nexrad contains a rich variety of information. You get precipitation intensity; you get spectral components and spectral widths.

Mr. GLICKMAN. But, again, the most significant thing is that that controller who is telling that airplane where to go will know exactly where turbulent weather is at that time.

Mr. ALBRECHT. That is right.

Mr. GLICKMAN. Thank you.

Phase III work is related to interfacing Nexrad with the Center weather processor and will be completed in time for the implementation of Nexrad in fiscal year 1987. (Viewgraph 19.)

Development is required on a modernized Voice Switching and Control System (called VSCS) to support flexible operations at new and consolidated air route traffic control centers, to reduce leased line and equipment costs, enhance controller productivity, and permit the eventual transmission of voice and data over an aeronautical satellite-based system. The VSCS system will become an integral part of the advanced automation system and will provide automatic switching of communications changes to match changing sector airspace coverage. In fiscal year 1982, the VSCS specification will be developed. In fiscal year 1983, the request for proposals will be issued and a contract awarded for the new uses in fiscal year 1984. The new system will be available in fiscal year 1987. (Viewgraph 20.)

Our E. & D. navigation program includes two major activity areas. The first addresses near-term items such as sustaining engineering on VOR DME, NDB, ILS, and establishing certification criteria for supplemental RNAV systems including Loran-C and Omega. The other program area includes the activities needed to support elements of the radionavigation system. This program is being conducted in support of the Federal radionavigation plan or FRP which is a joint DOT/DOD effort. (The FRP is revised annually, and the 1982 edition will be available in the late spring.)

The FAA is assessing Vortac, Loran-C, and Navstar GPS as prime elements of the proposed system mix. The approach being taken is to assess and compare the institutional, economic, and technical performance of each system and system mixes. Because of the unique potential of Navstar GPS, special emphasis is being placed on its evaluation. The FAA peliminary recommendation for the future system mix will be developed by the end of 1982. A joint DOT/DOD preliminary recommendation will be available by the end of 1983, and a final joint DOT/DOD recommendation will be made in 1986. (Viewgraph 21.)

Yes, Mr. Dunn?

Mr. DUNN. Will the NDB's be phased out as MLS is phased in, or separately, or what?

Mr. BLAKE. There is no program to phase out the NDB's as MLS is brought in. They, as you know, provide several services, locator service, and also are a part of the weather dissemination process. The current plan is to continue NDB service into the nineties.

Mr. DUNN. Into the nineties? The Director yesterday talked about the high maintenance costs, particularly, of those services.

Mr. BLAKE. A few will be replaced of the very early vintage during that time period.

Mr. DUNN. Thank you.

The FAA has been involved in the evaluation of NAVSTAR/GPS for civil aviation use since 1979 utilizing a loaned military "Z" set. Results of tests to date confirm the outstanding accuracy performance of the undegraded signal. However analysis has identified several problem areas for civil aviation use of NAVSTAR GPS. One of these is that the current 18 satellite constellation does not provide 5 satellites in view in proper geometry at all times which is the minimum coverage necessary to equal the current VOR performance and provide backup for satellite failure. Another technical consideration unresolved is the integrity of the navigation information presented to the pilot. It takes time before an error/malfunction is detected and the pilot made aware of it.

Our initial cost analysis showed that NAVSTAR GPS is the most expensive of the proposed systems for civil aviation. However, DOT is now involved in a multimodal cost analysis to update the earlier work. Results are due in the late spring (May 1982).

There are many institutional issues with proposing a DOD system for domestic use. One is the control of the system, in terms of both accuracy level and availability.

Currently the proposed accuracy that DOD will provide in 1989 is 500 meters (with 95 percent probability), which does not meet the accuracy requirements for all navigation services in civil aviation. Another issue that is currently being studied is cost recovery for the NAVSTAR GPS program. The usual method of cost recovery for aviation users has been some type of user tax. This has worked fine for domestic systems, but NAVSTAR GPS will be international which raises a different problem. Although FAA currently has no viable solution for the NAVSTAR GPS cost recovery issue, a few comments are in order. Although the current 18 satellite system with degraded signal accuracy does not appear to meet the accuracy and reliability requirements of civil aviation, an improved version of the system could be considered as a potential replacement for VOR DME. The service, however, must be available to civil aviation at a cost that is no higher than they now pay for the current service. Although NAVSTAR GPS has the potential of providing additional services, the value of these services is not known and many of the users may not need or desire them. Therefore, cost recovery proposals for NAVSTAR GPS must be considered in light of total services provided to all users—military, civil, and international. During the next few years FAA plans to continue its evaluation of GPS for civil applications to collect data and develop procedures needed to define the potential of GPS as a civil operating system. (Viewgraph 22.)

The development activities associated with MLS are essentially complete. Our current efforts are geared to obtaining international approval of standards and recommended practices (that is, SARPS) for the precision version of the internationally standardized distance measuring equipment (DME). The preparation of draft precision DME SARPS will be completed in fiscal year 1982 and the all-weather operations panel is expected to approve them in fiscal year 1983, with full ICAO approval scheduled for fiscal year 1984. We expect operational implementation of MLS to begin in 1985. (Viewgraph 23.)

Advanced concept research and exploration is needed to keep FAA in the forefront of technology and to assure readiness to embrace new ideas and new concepts which may improve the NAS. I would like to discuss several items of our advanced concept efforts which we currently have underway.

There is a need to evaluate the utilization of new sensor technology for developing a practical solution to the wake vortex problem. Evaluation of the FM-CW pulsed doppler radar will be completed in fiscal year 1982. Sensor technology explorations which may have an application to detect and actively track the wake vortices will continue. Assuming successful development of a sensor, we hope to have an advanced vortex system detection and avoidance concept design by fiscal year 1986.

We have conducted an aggressive program to improve airport capacity for a number of years now. We have completed airport and airspace capacity and delay model development and have completed capacity and delay studies for many of our high density airports.

Human limitations constitute a major cause of accidents and errors today. Future systems must be human-error tolerant and provide the proper allocation of functions between man and machine. Our human factors program is aimed at system performance enhancement and error reduction, both in the cockpit and on the ground.

Major efforts include the development and investigation of basic human factors technology to resolve man-machine problems in aviation systems, to identify requirements for human factors research, and studies to identify and resolve human factor problems in the future aviation system. Our human factors activity is being conducted jointly with NASA and DOD. The experiments to be conducted will utilize human factor laboratories located at NASA Ames, NASA Langley, Wright Patterson Flight Dynamic Laboratory, and the FAA Technical Center.

We must assure that future systems with high levels of automation, such as our advanced computer system use reliable, fault-tolerant hardware and software technology to minimize the disruptions in the ATC system.

Investigation of intelligent computer systems to assume more of the manual ATC decisionmaking process will continue.

Our satellite applications program is looking for ways to improve ATC system performance using satellite technology.

We are looking at satellite systems to satisfy future CONUS ATC functional requirements in a manner that is compatible with the anticipated evolution of the ground-based system. Specifically, we will investigate the feasibility of using mode S in conjunction with satellites as a basis for the future ATC surveillance system and the technical and operational characteristics of a space-based surveillance system.

Our current cockpit systems integration program is looking at finding better ways to display information to pilots in the cockpit. FAA is currently evaluating the use of CDTI as an aid to the pilot in achieving a better awareness of the ATC situation. (Viewgraph 24.)

In summary, there are major benefits to the aviation community which will be achieved from the engineering and development programs supporting the NAS plan. These include: increased safety from improved collision avoidance systems and improved distribution of hazardous weather information; reduced fuel consumption associated with shorter delays at the major airports; and implementation of AERA navigation type procedures which will allow point-to-point navigation. A minimum of additional avionics will be required to obtain these additional services.

Implementing the NAS plan will be expensive and will take approximately 10 years to complete. Critically important to the success of the plan is the support of the aviation community and the Congress. It will require the concentrated effort and support of all elements of the community to first study, comment, and then—we hope—enthusiastically endorse this major FAA initiative. We solicit the committee's support in this endeavor.

That concludes my prepared statement, Mr. Chairman. At this time, my colleagues and I would be please to respond to you questions.

[Viewgraphs 1-24 follow:]

FAA's Engineering and Development Programs

U.S. Department
of Transportation

List of Current Development Activities (Supporting the NAS Plan)

A. ATC Automation

B. Flight Service Station Automation

C. Aircraft Separation Assurance

D. Surveillance, Weather, and Communications Systems Modernization

E. Navigation and Landing

F. Airports

G. Advanced Research and Development

Computer Modernization

Important Factors

- Current System Computer Capacity Is Sufficient Through Mid-1980's With Currently On-Going Improvements
- Available Computer Technology Is Needed to Provide Flexibility to Accommodate the Ranges of Facilities, Capacities and Functions Projected
- Use of Distributed Computers at the Controller Positions Will Provide Needed Flexibility and Reliability
- Technology Is Not a Problem—System Design Is
- Merging of En Route and Terminal Functions Is Needed and Beneficial

Computer Modernization Decision

- Replace Computer Hardware—(Step 1)
  - Keep Present Displays and Software
- New System Design—(Step 2)
  - New System Software
  - New Sector Control Suite
  - Builds on Above Computer Hardware
  - Initial Steps of Automated En Route ATC (AERA)
- Future Automation—(Step 3)
  - Automated En Route ATC (AERA)

Host Computer (Step 1)

Objective:

Hosting of the En Route (NAS) Software in New Computers Will Be the First Step Towards a Common Advanced ATC Automation System for En Route Centers, Consolidated Hubs, and Off Shore Centers.

Status:

— Request for Proposals	FY-82
— Contract Award—2 Contractors	FY-83
— Initiation of FAA Technical Center Demonstration	FY-84
— Operational Implementation	FY-86

System Design (Step 2)
(Sector Suites and New Software)

Objective:

An Overall System Design Including Development of New Sector Suites and a New Software System Utilizing Host Hardware Will Result in:

- Consolidation of Existing 23 ARTCC's and 188 Approach Control Facilities Into Approximately 50 ATC Facilities.
- Consolidation of ARTCC and Major Terminal/TRACONS With Common HW/SW System.
- Common Sector Suite Equipment in Both En Route and Terminal Hub Facilities
- ETABS/TIDS Programs Providing Inputs to Sector Suite Design.
- Common Offshore and Continental U.S. Automated En Route Systems.

Status:

— Request for Proposals	FY-82
— Contract Award	FY-83
— Production Award	FY-86
— 1st Sector Suite Operational	FY-87
— New Software Operational	FY-89

Automated En Route ATC (AERA)

Objective:

Automate Routine En Route ATC Functions to Provide Increased Productivity, Increased Safety and Better Accommodation of Pilot's Preferences.

Status:

- AERA Package #1 (Step 2)
  (Including Fuel Efficient Clearances and Accommodation of Preferred Routing Requests)
  - Completed Data Processing Requirements for Sizing Host — FY-82
  - Completion of Requirements Specification — FY-82
  - Continue Man-Machine Experiments — FY-83
  - Operational Implementation — FY-89
- AERA Package #2 (Step 3)
  (Including Automatic Conflict Probe and Automatic Generation of ATC Clearance Messages)
  - Completion of Requirements Specification — FY-84
  - Operational Implementation — FY-92

FSS Automation

Objectives:

- Promote Flight Safety Through More Accurate and Timely Pilot Briefings
- Meet Forecast Increased Demand for Services (79% Growth in Hours Flown by 1993)
- Reduce Costs to Provide Services ($1.5 Billion in Savings by 1995)

FSS Automation Status

Model 1

— Production Contract Awarded (Including Model 2)	FY-81
— Hardware Delivery to FAA Technical Center	FY-82
— Operational Implementation	FY-82

Model 2

— Delivery to FAA Technical Center	FY-83
— Operational Implementation	FY-84

Model 3

— Public Demonstration of Voice Response System	On-Going
— Award FSAS Initial Enhancement Contract	FY-83
— Issue Request for Proposals for Additional Enhancements	FY-83
— Operational Implementation	FY-85

Support of the NAS System

Aircraft Separation Assurance

- Conflict Alert and Conflict Resolution
  - Primary System for Assisting Controllers in Reducing System Errors
- Traffic Alert and Collision Avoidance System (TCAS)
  - Backup System for Resolving Near Midair Collision Situations
- An Automatic Traffic Advisory Service May Be Implemented for Limited Terminal Applications

TCAS System Properties

- Independence From the Ground
  - Capable of Compatible Operation With Current and Evolving ATC System
- Based on Internationally Standardized ATC Radar Beacon System—Secondary Surveillance Radar (SSR)
- Range of Capabilities
  - TCAS I—Lowest Cost for Given Level of Protection
  - TCAS II—Maximum Protection for All Environments

TCAS II Requirements

Minimum

- Vertical Maneuvers
- Reliable Operation in High Density Airspace
- Intruder Bearing for PWI
- Crosslink Traffic and Maneuver Advisories to TCAS I; Maneuver Coordination With TCAS II
- Less Than 2 Percent Degradation of Ground Surveillance

Enhancements

- Use of Intruder Bearing Data for Horizontal Miss Distance Assessment (Alarm Reduction)
- Use of Intruder Bearing Data for Horizontal Resolution Maneuvers

TCAS-I Functions and Components

- Provides Surveillance Element for Ground ATC and TCAS-II
  - Transponder
  - Encoding Altimeter
- Displays Maneuver Intent Crosslinked From TCAS-II
  - Transponder Must Be Mode A/C/S
  - TCAS-II Advisory Display
- Listens for Transmissions From Nearby Transponders
  - Passive Transponder Detector

TCAS Program Status

TCAS II

— Draft National Standard for Minimum TCAS II	FY-82
— Minimum Operational Performance Standards and Final National Standard for Minimum TCAS II	FY-82
— Minimum Operational Performance Standards for Enhanced TCAS II	FY-84
— Initial Air Carrier Installations of TCAS	FY-84

TCAS I

— Completed Design Guidelines	FY-82
— Initial Installations of TCAS I	FY-83

Automatic Traffic Advisory Service (ATAS)

Objective:

To Provide Ground-Derived Traffic Advisories in Selected High Density Traffic Areas as Well as Terrain/Obstacle/Restricted Airspace Advisories to Equipped Aircraft Via the Mode S Data Link.

Status:

— ATAS Draft National Aviation Standard	FY-82
— Publish Proposed Final ATAS National Aviation Standard	FY-83
— ATAS Operational Evaluation Report	FY-84

Weather System Modernization

- Weather Radar (NEXRAD)
- Collection and Dissemination of Weather Data (Center Weather Service Unit)
- Automated Weather Observation Systems

Next Generation Doppler Weather Radar (NEXRAD)

Objectives:

Joint DOC, DOD, DOT Program to Develop the Next Generation Doppler Weather Radar.

- **Provide Additional Capability Through Doppler Principle, i.e., Radial Wind Velocity, Turbulence.**
- **Provide Weather Radar for En Route ATC Operations and Many Terminal ATC Operations.**

Status:

— Awarded NEXRAD Multiple System Design Contract	FY-82
— Completed NEXRAD Cost Benefit Analysis	FY-82
— Awarded NEXRAD Multiple Validation Phase Contract	FY-83
— Awarded NEXRAD Full-Scale Development Contract	FY-85
— Initial Implementation	FY-87

Center Weather Service Unit (CWSU)/ Center Weather Processor (CWP)

Objectives:

- Improve Accuracy, Timeliness and Availability of Aviation Weather Forecasts, for Time Period "Now" to "6 Hours From Now."
- Provide Integrated Aviation Weather Subsystem to National Airspace System (NAS) Which Will Upgrade Weather Support to ATC Facilities

Status:

— Phase I—Automation of CWSU Work Station and Capability to Disseminate Weather Data to ATC Specialists and Pilots	
• Completed Engineering Requirement for Center Weather Processor (CWP)	FY-82
• Issued Request for Proposals for CWP	FY-83
• Operational Implementation of CWP	FY-85
— Phase II—Provide Weather Contours on Controllers' Displays	
• Completed Feasibility Demonstration Using Field Controllers	FY-82
• Completed Software Development	FY-83
• Operational Implementation	FY-85
— Phase III—Interface NEXRAD With CWP	
• Completed Specification for Processing Doppler Weather Radar Data	FY-86
• Operational Implementation (Concurrent With NEXRAD)	FY-87

Voice Switching and Control System (VSCS)

Objectives:

Provide a Voice Switching and Control System to:

- Support Flexible Operations in New and Consolidated Air Route Traffic Control Centers
- Reduce Leased Line and Equipment Costs
- Enhance Controller Productivity
- Permit the Eventual Transmission of Voice and Data Over an Aeronautical Satellite-Based System
- Suitable for Both the Enroute and Terminal Operations of the FAA System

Status:

— Developed VSCS Specification	FY-82
— Issued Request for Proposals	FY-83
— Awarded Prototype Contract	FY-84
— Evaluation of Prototypes Completed	FY-86
— Operational Implementation	FY-87

FAA Navigation

Near Term

- LORAN-C Off Shore, Remote Area Navigation Certification

Future System

- Analysis of Alternative System Configurations
  - Cost Analysis Studies
  - Technical Evaluations, LORAN-C, GPS, Area Navigation
  - GPS Emphasis
  - FAA Assessment

NAVSTAR/GPS

Objective:

- Define the Future Role of NAVSTAR/GPS as an Element of the Civil Aviation Navigation System

Implementation Considerations:

- Institutional
  - System Control (Denial of Access/Accuracy)
  - International Standardization for Civil Use
- Cost
  - Cost Recovery Policy
  - User Equipment Cost
- Technical
  - Accuracy
  - Coverage
  - Reliability/Integrity

FEB 1 9 1982

STATEMENT OF ALBERT P. ALBRECHT, ASSOCIATE ADMINISTRATOR FOR ENGINEERING AND DEVELOPMENT, FEDERAL AVIATION ADMINISTRATION, BEFORE THE HOUSE COMMITTEE ON SCIENCE AND TECHNOLOGY, SUBCOMMITTEE ON TRANSPORTATION, AVIATION AND MATERIALS CONCERNING THE FAA R,E&D PROGRAM. FEBRUARY 24, 1982

GOOD AFTERNOON MR. CHAIRMAN AND MEMBERS OF THE SUBCOMMITTEE. I AM AL ALBRECHT, THE ASSOCIATE ADMINISTRATOR FOR ENGINEERING AND DEVELOPMENT. I HAVE AT THE TABLE WITH ME MR. NEAL BLAKE, MY DEPUTY, AND FOR EXPERT BACKUP I HAVE SITTING BEHIND ME DR. ED KOENKE, DIRECTOR OF THE FAA TECHNICAL CENTER, MR. VAL HUNT, DIRECTOR OF THE ADVANCED AUTOMATION PROGRAM OFFICE, MR. BOB WEDAN, DIRECTOR OF THE SYSTEMS RESEARCH AND DEVELOPMENT SERVICE, AND MR. MARTY POZESKY, DEPUTY DIRECTOR OF THE SYSTEMS RESEARCH AND DEVELOPMENT SERVICE.

YESTERDAY, MR. HELMS BRIEFED YOU ON THE NATIONAL AIRSPACE SYSTEM (THAT IS, NAS) PLAN--OUR AGENCY WIDE EFFORT TO CHART A COMPREHENSIVE PLAN FOR MODERNIZING AND IMPROVING THE AIR TRAFFIC CONTROL (THAT IS, ATC) AND AIRWAY FACILITIES SYSTEMS FROM NOW TO THE YEAR 2000. THIS NAS PLAN DESCRIBES THE RESEARCH, DEVELOPMENT AND ENGINEERING NECESSARY TO SUPPORT FAA'S MODERNIZATION AND IMPROVEMENT EFFORTS FOR AIR TRAFFIC CONTROL SERVICES, FLIGHT SERVICES, WEATHER SERVICES AND NAVIGATION FACILITIES. BECAUSE THE NAS PLAN ONLY DESCRIBES THOSE RESEARCH ACTIVITIES WHICH DIRECTLY SUPPORT F&E MODERNIZATION ACTIVITIES, I HAVE DIRECTED THE PREPARATION OF A "COMPANION" DOCUMENT, WHICH ALSO INCLUDES THE ADDITIONAL RESEARCH AND

DEVELOPMENT ACTIVITIES REQUIRED TO SUPPORT AIRCRAFT SAFETY AND AVIATION SECURITY, INVESTIGATION OF ADVANCED CONCEPTS AND APPLICATION OF ADVANCED TECHNOLOGY, AIRPORTS RESEARCH AND DEVELOPMENT, AND AVIATION MEDICINE.

IN PREPARING THE NEW R&D PLAN AND SUPPORTING BUDGET REQUESTS, PRIORITY HAS BEEN PLACED ON THOSE ITEMS SUPPORTING THE NAS PLAN. THIS INCLUDES IMPROVEMENT OF EN ROUTE FACILITIES, TERMINAL FACILITIES, FLIGHT SERVICE STATIONS, GROUND-TO-AIR SYSTEMS, AND INTERFACILITY COMMUNICATIONS. TODAY, I WILL DESCRIBE THE STATUS OF OUR ENGINEERING AND DEVELOPMENT ACTIVITIES, WITH PARTICULAR ATTENTION TO THOSE WHICH DIRECTLY SUPPORT THE NAS PLAN. MANY OF THE FY-1982 MILESTONES IN MY TESTIMONY ARE CONTINGENT ON FAA'S RECEIVING AN FY-1982 SUPPLEMENTAL APPROPRIATION OF $16 MILLION. OUR PROPOSED ACCOMPLISHMENTS IN FY-1982 ARE DEPENDENT ON RECEIVING THE FY-1982 SUPPLEMENTAL AND A $23.5 MILLION FY-1983 AMENDMENT PROPOSED FOR LATER TRANSMITTAL. THESE TWO AMENDMENTS WILL HAVE TO BE JUSTIFIED SEPARATELY TO CONGRESS. I WILL ALSO UNDERSCORE AND REVIEW SOME THE POINTS THAT MR. HELMS MADE YESTERDAY, SO SOME OF MY VISUALS WILL BE FAMILIAR TO YOU.

(VIEWGRAPH #1 OFF   VIEWGRAPH #2 ON)

THE POLICY EMPHASIS USED IN ARRIVING AT THE NAS PLAN CONCENTRATED ON A TOTAL SYSTEMS APPROACH, WHICH WAS FLEXIBLE ENOUGH TO ACCOMMODATE FUTURE DEMANDS ON THE SYSTEM AND TO EXPLOIT NEW TECHNOLOGY WHERE PRACTICAL. THE PLAN IDENTIFIES SEGMENTS OF THE AVIATION COMMUNITY WHERE WE HAVE PROVIDED INCREASED EMPHASIS, FOR EXAMPLE, ROTARY WING OPERATIONS, AND DESCRIBES WHAT WE'RE DOING IN THESE AREAS.

WE WANT TO IMPROVE VITAL SAFETY SERVICES TO THE AVIATION COMMUNITY--FOR EXAMPLE, COLLISION AVOIDANCE, IMPROVED WEATHER SERVICES, AND LANDING SYSTEMS.

WE WANT TO DRIVE THE EVOLUTION OF THE SYSTEM BY INTEGRATION OF ATC SYSTEM FUNCTIONS, WITH A HIGH DEGREE OF COMMONALITY OF SYSTEM COMPONENTS TO PROVIDE OPERATIONAL FLEXIBILITY IN MEETING GROWING DEMAND.

(VIEWGRAPH #2 OFF   VIEWGRAPH #3 ON)

FAA WILL INCREASE THE LEVEL OF AUTOMATION TO THE DEGREE NEEDED TO ACHIEVE A HIGHER LEVEL OF PRODUCTIVITY AND HIGHER CAPACITY AND TO ACCOMMODATE USER DESIRES FOR MORE FUEL EFFICIENT OPERATIONS.

MODERN TELECOMMUNICATIONS WILL PERMIT CONSOLIDATION OF FACILITIES TO CAPTURE ECONOMIES OF SCALE.

MODERNIZATION OF OUR 20+-YEAR-OLD PHYSICAL PLANT WILL BE ACCOMPLISHED THROUGH A MIXTURE OF SELECTIVE REFURBISHMENT, REPLACEMENT, AND ELIMINATION OF UNNEEDED FACILITIES.

WE WANT TO MOVE TOWARD LOCAL SPONSORSHIP OF THOSE SERVICES AND FACILITIES WHICH ARE BEST PROVIDED OUTSIDE THE FEDERAL FRAMEWORK.

ONE OF THE FIRST DECISIONS RESULTING FROM MR. HELM'S TECHNICAL REVIEW WAS THE SELECTION OF THE TRAFFIC ALERT AND COLLISION

AVOIDANCE SYSTEM (THAT IS, TCAS) AS AN INDEPENDENT BACKUP TO THE ATC SYSTEM. I WILL DISCUSS THIS SYSTEM IN MORE DEPTH LATER IN THE PRESENTATION.

(VIEWGRAPH #3 OFF VIEWGRAPH #4 ON)

LET ME TOUCH BRIEFLY ON THE SERIES OF MAJOR DECISIONS ON WHICH THE NAS PLAN IS BASED:

- IT HAS BEEN DECIDED THAT GROUND-BASED ATC SERVICES WILL CONTINUE TO BE THE FUNDAMENTAL MEANS FOR ENSURING AIRCRAFT SEPARATION, BUT SERVICES WILL BE PROVIDED IN SUCH A WAY THAT THE USERS WILL HAVE MAXIMUM FLEXIBILITY OF OPERATIONS CONSISTENT WITH SYSTEM SAFETY.

  THIS HAS BEEN A CONTROVERSIAL ISSUE WITH CERTAIN ELEMENTS OF THE AVIATION COMMUNITY WHO BELIEVE THAT WE SHOULD MOVE TOWARD A SYSTEM IN WHICH THE PILOT HIMSELF IS RESPONSIBLE FOR THE BULK OF THE SEPARATION TASK. FAA HAS DONE A SERIES OF STUDIES, WITH PARTICIPATION BY THE AVIATION COMMUNITY, TO EXAMINE ALTERNATIVE SEPARATION CONCEPTS. WE ARE, FOR EXAMPLE, EXPLORING WAYS OF USING DISPLAYS OF TRAFFIC INFORMATION IN THE COCKPIT TO DETERMINE WHETHER THE PILOT CAN ACCEPT ADDITIONAL RESPONSIBILITIES IN THE SEPARATION PROCESS. HOWEVER, WHILE SUCH METHODS CAN BE USEFUL AND WHILE THERE MAY, IN COMING YEARS, BE A SHIFT IN THE RESPONSIBILITY FOR CERTAIN ADDITIONAL FUNCTIONS FROM THE TRAFFIC CONTROL SYSTEM TO THE COCKPIT, WE BELIEVE THAT SAFE AND EFFICIENT MANAGEMENT OF TRAFFIC FLOWS MUST BE DONE BY THE GROUND-BASED ATC SYSTEM.

- FAA PLANS TO MAKE A MAJOR CHANGE IN ITS COMMUNICATIONS SYSTEM, TO ACHIEVE THE BENEFITS OF USING NETWORKING, TRUNKING, AND SATELLITE FIXED SERVICES, WHERE COST EFFECTIVE, FOR DIGITAL DATA EXCHANGE. IN ADDITION, THE AGENCY'S OBSOLETE VOICE SWITCHING AND CONTROL SYSTEM WILL BE MODERNIZED TO SUPPORT FLEXIBLE OPERATIONS AT NEW AND CONSOLIDATED FACILITIES, REDUCING LEASED LINE AND EQUIPMENT COSTS SIGNIFICANTLY.

- ILS WILL BE SUPPLEMENTED BY, AND SUBSEQUENTLY REPLACED, BY MLS. IN ORDER TO ACHIEVE THE BENEFITS OF MLS AT THE EARLIEST POSSIBLE TIME, THE INSTALLATION OF NEW ILS'S WILL BE LIMITED TO THOSE NECESSARY TO REPLACE OBSOLETE VACUUM TUBE-TYPE ILS SYSTEMS.

- IT IS COMMON KNOWLEDGE THAT LACK OF RUNWAY CAPACITY AT THE BUSIEST AIRPORTS REPRESENTS A MAJOR CONSTRAINT ON TRAFFIC GROWTH. FAA HAS BEEN WORKING FOR SOME YEARS TO IMPROVE THE CAPACITY OF MAJOR AIRPORTS. WE WILL CONTINUE TO DEVELOP MEANS OF ACHIEVING IMPROVED THROUGHPUT AND PERFORMANCE AT THESE AIRPORTS WHICH AFFECT SO MUCH OF THE TOTAL SYSTEM.

- MAJOR GAINS IN SYSTEM EFFICIENCY AND PRODUCTIVITY CAN BE ACHIEVED THROUGH CONSOLIDATION OF FACILITIES, COMMONALITY OF EQUIPMENT, AND AUTOMATION OF THE MORE ROUTINE ATC FUNCTIONS.

- AUTOMATED AND SEMIAUTOMATED WEATHER OBSERVATION SYSTEMS WILL ASSIST PERSONNEL IN MAKING WEATHER OBSERVATIONS AT MANNED FACILITIES AND PROVIDE OBSERVATIONS FROM UNMANNED FACILITIES.

- DIRECT PILOT ACCESS TO REAL-TIME WEATHER WILL BE PROVIDED THROUGH IMPROVEMENTS TO OUR FLIGHT SERVICE STATION AUTOMATION SYSTEM.

(VIEWGRAPH #4 OFF VIEWGRAPH #5 ON)

- YOU HAVE ALL READ AND HEARD MUCH ABOUT THE PERFORMANCE OF FAA'S AUTOMATION SYSTEMS. MUCH OF THE PAST PUBLICITY HAS BEEN LESS THAN ACCURATE. OUR AUTOMATION SYSTEM IS SAFE AND EFFECTIVE. YET, THERE IS LITTLE QUESTION THAT MAJOR MODERNIZATION AND UPGRADING OF FAA'S AUTOMATION SYSTEMS IS ESSENTIAL.

THE ADMINISTRATOR HAS MADE THE DECISION TO REPLACE THE EXISTING EN ROUTE AND TERMINAL COMPUTERS AND DISPLAY SYSTEMS WITH A MODERN, HIGHLY RELIABLE COMPUTER AND DISPLAY SYSTEM CAPABLE OF SUPPORTING HIGH LEVELS OF AUTOMATION OF THE ATC PROCESS.

- FAA WILL ALSO PROCEED WITH THE UPGRADING OF TERMINAL AUTOMATION SYSTEMS, ARTS II AND III, SINCE THESE UPGRADINGS WILL PROVIDE IMPROVED SYSTEM SAFETY AND PRODUCTIVITY FOR THE INTERIM UNTIL NEW SECTOR SUITES CAN BE PROVIDED FOR TERMINAL OPERATIONS.

- FAA WILL MAKE A SIGNIFICANT IMPROVEMENT IN THE QUALITY AND EFFICIENTLY OF PROVIDING FLIGHT SERVICES INFORMATION

(PREDOMINANTLY WEATHER AND FLIGHT PLANS) TO ALL USERS. THE IMPLEMENTATION OF THE AUTOMATED FLIGHT SERVICE STATION PROGRAM IS AN INTEGRAL PART OF THIS MODERNIZATION.

- THE ATC MANAGEMENT FUNCTION WILL BE MODERNIZED AND A HIGH LEVEL OF INTEGRATION PROVIDED BETWEEN NATIONAL, EN ROUTE, AND TERMINAL FLOW MANAGEMENT FUNCTIONS. THE INTEGRATED MANAGEMENT OF AIRCRAFT FLOW WILL HELP MAKE THE BOUNDARIES BETWEEN THE EN ROUTE AND THE TERMINAL SYSTEMS TRANSPARENT AND THEREBY PERMIT EFFICIENT MANAGEMENT OF TRAFFIC UNDER VARYING AIRPORT ACCEPTANCE RATES.

(VIEWGRAPH #5 OFF VIEWGRAPH #6 ON)

- A DECISION HAS BEEN MADE TO UTILIZE THE RESULTS OF PREVIOUS AND ON-GOING DEVELOPMENT ACTIVITIES FOR AIRBORNE COLLISION AVOIDANCE SYSTEMS TO ESTABLISH TWO AIRBORNE SYSTEMS CAPABLE OF OPERATIONS INDEPENDENT OF ANY GROUND SYSTEM IMPLEMENTATION--CALLED TCAS-I AND TCAS-II. TCAS-II WILL BE A FULL-SCALE COLLISION AVOIDANCE SYSTEM CAPABLE OF OPERATING IN HIGH-DENSITY AIRSPACE AND PROVIDING NOT ONLY COLLISION AVOIDANCE INFORMATION, BUT ALSO A DIRECTION-TO-LOOK FOR THE PILOT TO SPOT CONFLICTING AIRCRAFT. TCAS-I IS A NEW SYSTEM WHICH WILL BE ABLE TO RECEIVE AND DISPLAY INFORMATION FROM TCAS-II, AND WILL PROVIDE A WARNING ON THE PROXIMITY OF TCAS-I AND OTHER TRANSPONDER-EQUIPPED AIRCRAFT. THE HEART OF TCAS-I AND TCAS-II IS THE ALTITUDE-REPORTING MODE S TRANSPONDER.

- A DECISION HAS BEEN REACHED TO TRANSITION FROM THE EXISTING AIR TRAFFIC CONTROL RADAR BEACON SYSTEM TO THE FAR MORE CAPABLE SECONDARY SURVEILLANCE RADAR MODE S SYSTEM, WITH ITS INTEGRAL DATA LINK CAPABILITY.

FAA EXPECTS TO ADVISE AVIATION USERS THAT TRANSPONDERS PURCHASED AFTER 1986 WILL NEED TO BE ALTITUDE-REPORTING MODE S TRANSPONDERS. AFTER 1990, AIRCRAFT WILL NEED TO BE EQUIPPED WITH ALTITUDE-REPORTING MODE S TRANSPONDERS ABOVE 12,500 FEET, AND BY THE YEAR 2000 ABOVE 6,000 FEET, IF THEY WISH TO PARTICIPATE IN THE ATC SYSTEM AND RECEIVE FAA SERVICES.

THE DECISION TO IMPLEMENT THE MODE S IMPROVEMENT OF THE AIR TRAFFIC CONTROL RADAR BEACON SYSTEM IS A CORE DECISION BECAUSE MODE S NOT ONLY PROVIDES FOR A SIGNIFICANTLY BETTER AND MORE ACCURATE SURVEILLANCE CAPABILITY, BUT IT PAVES THE WAY FOR DIRECT AUTOMATIC COMMUNICATIONS BETWEEN THE AIRCRAFT AND THE AUTOMATED GROUND CONTROL SYSTEM THROUGH ITS INTEGRAL MODE S DATA LINK.

- IT IS EXPECTED THAT EN ROUTE PRIMARY RADAR FOR ATC SEPARATION SERVICES WILL BE PHASED OUT BY THE YEAR 2000. PRIMARY RADAR FOR TERMINAL OPERATIONS WILL CONTINUE TO BE A REQUIREMENT FOR THE IMMEDIATE FUTURE. FAA WILL PROCEED WITH THE PROCUREMENT OF THE NEW TERMINAL RADAR ASR-9, INCLUDING A MOVING TARGET DETECTOR (MTD) AND A WEATHER CHANNEL. THE NEW RADAR WILL INCLUDE A MODE S INTERFACE.

Microwave Landing System

Objective:

- Develop and Implement New Terminal Guidance System With Improved Accuracy and Operational Flexibility

Status

— Preparation of Draft Precision Distance Measuring Equipment (PDME) Standards and Recommended Practices (SARPS)	FY-82
— PDME SARPS AWOP* Approval	FY-83
— PDME SARPS Approval by ICAO	FY-84
— Start MLS Operational Implementation	FY-85

*All Weather Operations Panel

Advanced Research and Development

Investigation of Advanced Control Concepts and Application of Advanced Technology to Improve the ATC System Including:

- **Practical Wake Vortex Detection and Avoidance Methods**
- **New Ways to Achieve Airport Capacity Including Management of Runway Occupancy Time**
- **Optimal Human Roles in Highly Automated Systems**
- **Fault-Tolerant Computer Systems**
- **Computer-Aided Reasoning in ATC and Cockpit Operations**
- **Advanced Applications on Satellites for ATC Surveillance (Mode S Avionics)**
- **Optimal Cockpit System Integration in the Evolving ATC System**

User Benefits

- Increased Safety Through Collision Avoidance and Improved Weather Information
- Reduced Delays
- Reduced Fuel Consumption
- Proliferation of Point-to-Point Navigation
- No Additional Equipage Required for Most New Services

Improved weather services for the ATC system function will be provided by a new ATC weather radar. It is FAA's intention to provide Doppler weather information probably using the inputs from the national NEXRAD weather radar system.

(Viewgraph #6 off   Viewgraph #7 on)

I will now proceed with a status report on the major programs which make up our engineering and development efforts, concentrating on those which directly support the NAS Plan. The presentation will cover the areas shown on this viewgraph, which represent our major engineering and development areas.

(Viewgraph #7 off   Viewgraph #8 on)

Our ATC automation efforts are divided into two categories--those near-term enhancements which are scheduled to be implemented prior to the computer system replacement and those activities associated with the new automation system. The near-term enhancements are summarized on this viewgraph.

(Viewgraph #8 off   Viewgraph #9 on)

This development will result in an enhancement to the current conflict-alert function in use in the en route system. The software development will extend the conflict-alert function to include cases where IFR aircraft approach potential conflict situations with VFR aircraft which are equipped with altitude

REPORTING (MODE C) TRANSPONDERS. SOFTWARE DEVELOPMENT WILL START IN 1983, AND WE EXPECT THIS CAPABILITY TO BE IN PLACE AND OPERATING BY FY-85.

(VIEWGRAPH #9 OFF VIEWGRAPH #10 ON)

A CONFLICT RESOLUTION ADVISORY FUNCTION IS BEING DEVELOPED AS AN EXTENSION TO THE EN ROUTE CONFLICT-ALERT FUNCTION TO PROVIDE THE RADAR CONTROLLER WITH A DISPLAY OF ALTERNATIVE CONFLICT RESOLUTION ACTIONS WHICH COULD BE TAKEN TO RESOLVE A CONFLICT DETECTED BY THE CONFLICT-ALERT FUNCTION. THE OBJECTIVE OF THIS DEVELOPMENT IS TO REDUCE THE NUMBER OF SYSTEM ERRORS (THE VIOLATION OF SEPARATION MINIMA) BY REDUCING CONTROLLER DECISIONMAKING TIME IN COMPLICATED AIRCRAFT ENCOUNTER SITUATIONS. SOFTWARE DEVELOPMENT WILL BE UNDERWAY DURING 1983, AND THIS ENHANCEMENT WILL BE AVAILABLE IN FY-1985 FOR INITIAL IMPLEMENTATION.

(VIEWGRAPH #10 OFF VIEWGRAPH 11 ON)

AS PART OF FAA'S EFFORT TO HELP CONTROLLERS ACHIEVE MORE EFFICIENT AIRCRAFT FLIGHT PROFILE MANAGEMENT, AN ENHANCED EN ROUTE METERING SYSTEM IS BEING DEVELOPED TO ALLOW DELAY ABSORPTION AND OPTIMAL FUEL DESCENT PROFILES FOR EN ROUTE AIRCRAFT TRANSITIONING INTO TERMINAL AREAS. THE OBJECTIVE IS TO ORGANIZE THE TRAFFIC AT HIGHER ALTITUDES IN THE EN ROUTE AIRSPACE SO THAT CONGESTION AND DELAYS IN THE TERMINAL AREA CAN BE KEPT TO A MINIMUM. THIS ENHANCEMENT WILL BE AVAILABLE NEXT YEAR.

(VIEWGRAPH #11 OFF VIEWGRAPH #12 ON)

A NEAR-TERM IMPROVEMENT TO THE LOWER ACTIVITY TERMINAL AUTOMATION SYSTEM IS UNDER DEVELOPMENT TO ENHANCE THE ARTS II SYSTEM TO ARTS IIA BY ADDING BEACON TRACKING, MINIMUM SAFE ALTITUDE WARNING, CONFLICT-ALERT, AND A TRAINING TARGET GENERATOR. THESE ENHANCEMENTS WILL BE USED TO HELP ALERT CONTROLLERS TO POTENTIALLY HAZARDOUS SITUATIONS WHEN LESS THAN STANDARD SEPARATION EXISTS AND TO PROVIDE THE CAPABILITY TO TRAIN AND CERTIFY CONTROLLERS IN SELECTIVE AND VARIED CONTROL SITUATIONS IN A SIMULATED ENVIRONMENT. HARDWARE AND SOFTWARE DEVELOPMENT WILL BE INITIATED THIS YEAR AND CONTINUE IN FY-1983. TESTING OF THE HARDWARE MODIFICATION DESIGN TO ACCOMMODATE THESE IMPROVEMENTS WILL BE COMPLETED IN FY-1982. THIS ENHANCEMENT FUNCTION WILL BE READY FOR IMPLEMENTATION IN FY-1985.

(VIEWGRAPH #12 OFF VIEWGRAPH #13 ON)

A MAJOR PART OF THE NEW SYSTEM WILL BE A MODERNIZED ATC COMPUTER SYSTEM. THE PURPOSE IS TO PROVIDE NEEDED COMPUTER CAPACITY AND TO IMPROVE THE RELIABILITY OF THE PRESENT EN ROUTE SYSTEM COMPUTERS BY THE MID 1980'S. THIS COMPUTER SYSTEM WILL ALSO SERVE AS THE CORE OF THE FUTURE AUTOMATION SYSTEM WHICH WILL INCLUDE NEW SOFTWARE AND A NEW SYSTEM ARCHITECTURE WHICH WILL BE DESIGNED TO PROVIDE THE ADDITIONAL RELIABILITY AND FLEXIBILITY NEEDED TO ACCOMMODATE HIGHER LEVELS OF AUTOMATION. THE TECHNOLOGY IS CURRENTLY AVAILABLE FOR FAA TO UNDERTAKE THIS MAJOR MODERNIZATION EFFORT USING STATE-OF-THE-ART EQUIPMENT. THE SYSTEM DESIGN ACTIVITY, HOWEVER, WILL REQUIRE A MAJOR UPGRADING OF OUR SOFTWARE TO ACCOMMODATE THE FUTURE

REQUIREMENTS FOR ATC AUTOMATION SERVICES. BOTH EN ROUTE AND TERMINAL FUNCTIONS WILL BE MERGED INTO A COMMON SOFTWARE-HARDWARE SYSTEM.

(VIEWGRAPH #13 OFF   VIEWGRAPH #14 ON)

THE COMPUTER MODERNIZATION PROGRAM WILL BE BROKEN DOWN INTO PHASES. THE FIRST STEP OF SYSTEM DEVELOPMENT WILL BE REPLACEMENT OF THE EXISTING EN ROUTE COMPUTERS WITH NEW MODERN STATE-OF-THE-ART TECHNOLOGY SYSTEMS USING THE CURRENT DISPLAYS AND REHOSTING THE EN ROUTE SYSTEM SOFTWARE. A SECOND AND CONCURRENT STEP WILL BE THE DESIGN OF A NEW AUTOMATION SYSTEM WHICH WILL UTILIZE THE COMPUTERS PROCURED IN STEP 1 COMBINED WITH DEVELOPMENT AND IMPLEMENTATION OF MODERN CONTROLLER SECTOR SUITES ALONG WITH NEW SYSTEM SOFTWARE. THESE SYSTEM ELEMENTS WILL BE CONFIGURED IN A NEW SYSTEM ARCHITECTURE DESIGNED FOR HIGH RELIABILITY AND PROVIDING THE CAPABILITY TO FACILITATE THE IMPLEMENTATION OF THE FUTURE AERA FUNCTIONS AS THEY ARE DEVELOPED.

THE INITIAL AERA CAPABILITIES OF DIRECT ROUTE PLANNING AND IMPROVED FLOW MANAGEMENT WILL BE INCLUDED IN THE NEW SOFTWARE. IN STEP 3, THE HIGHER LEVELS OF AUTOMATION BEING DEVELOPED UNDER THE AERA PROGRAM WILL BE ADDED TO THE SYSTEM.

(VIEWGRAPH #14 OFF   VIEWGRAPH #15 ON)

THE PRESENT EN ROUTE COMPUTERS WILL BE REPLACED WITH NEW COMPUTERS WHICH CAN REHOST THE EXISTING EN ROUTE SYSTEM SOFTWARE AND INTERFACE

WITH THE CURRENT DISPLAY CHANNEL SYSTEMS. THE REHOSTING PHASE OF THE PROGRAM INVOLVES REHOSTING THE 9020 NAS MONITOR AND THE 9020 ATC APPLICATIONS SOFTWARE AS THE FIRST STEP TOWARDS ACHIEVING A COMMON ADVANCED ATC AUTOMATION SYSTEM FOR EN ROUTE CENTERS, CONSOLIDATED HUBS, AND OFF-SHORE CENTERS. THE NAS SOFTWARE IS ONE OF THE LARGEST, MOST COMPLEX, SOFTWARE PACKAGES EVER WRITTEN, AND THIS EFFORT WILL BE A MAJOR UNDERTAKING. WE EXPECT TO ISSUE THE RFP FOR THE NEW HARDWARE THIS SUMMER AND TO AWARD THE CONTRACT IN THE SUMMER OF 1983.

(VIEWGRAPH #15 OFF VIEWGRAPH #16 ON)

THE SECOND MAJOR ELEMENT OF THE ADVANCED COMPUTER SYSTEM IS THE DEVELOPMENT OF A NEW SECTOR SUITE, DEVELOPMENT OF NEW SYSTEM ARCHITECTURE, AND REDESIGN OF THE CURRENT SYSTEM SOFTWARE WHICH WILL UTILIZE THE NEW HOST HARDWARE. THE NEW SECTOR SUITES ARE INTENDED TO SUPPORT THE CONSOLIDATION OF CENTERS AND APPROACH CONTROL FACILITIES. IT IS ALSO EXPECTED THAT THIS CONSOLIDATION CAN BE ACCOMMODATED UTILIZING COMMON HARDWARE AND SOFTWARE SYSTEMS. THE NEW SECTOR SUITE IS INTENDED TO SUPPORT BOTH THE EN ROUTE AND TERMINAL ATC FUNCTIONS. SOFTWARE FUNCTIONS THAT ARE NOW UNIQUE TO TERMINAL ATC SYSTEMS WILL BE INCORPORATED INTO THE NEW SOFTWARE SO THAT IT CAN SUPPORT THE CONSOLIDATION OF TRACONS INTO CENTERS AND TERMINAL HUBS. THE EXPERIENCE DERIVED FROM BOTH THE ETABS AND TIDS PROGRAMS WILL BE INCORPORATED INTO THE SECTOR SUITE DESIGN. IT IS ALSO ENVISIONED THAT COMMON EQUIPMENT WILL BE UTILIZED FOR OFFSHORE AND EN ROUTE APPLICATIONS.

THE REQUEST FOR PROPOSALS FOR THE SECTOR SUITES, DESIGN OF THE NEW SYSTEM ARCHITECTURE, AND REDESIGN OF THE CURRENT SYSTEM SOFTWARE WILL ALSO BE AVAILABLE NEXT SUMMER. CONTRACT AWARD FOR TWO PARALLEL CONTRACTS WILL BE MADE IN THE SUMMER OF 1983.

(VIEWGRAPH #16 OFF VIEWGRAPH #17 ON)

THE OBJECTIVE OF THE AUTOMATED EN ROUTE AIR TRAFFIC CONTROL SYSTEM (AERA) PROGRAM IS TO ATTAIN THE HIGHEST PRACTICAL LEVEL OF ATC AUTOMATION, ALLOWING COMPUTERS TO DO AS MUCH OF THE ROUTINE WORK AS POSSIBLE THEREBY INCREASING THE PRODUCTIVITY OF SUPERVISORS AND CONTROLLERS.

EARLY FUNCTIONS OF THE AERA WILL BE PROVIDED WITH NEW SYSTEM SOFTWARE, WITH INCREASING AUTOMATION LEVELS PROVIDED IN FUTURE ENHANCEMENTS.

THE WORK WE HAVE DONE ON AUTOMATION OF THE ATC PROCESS ITSELF IN THE AERA DEVELOPMENT HAS CONVINCED US THAT WE CAN PROVIDE HIGH LEVELS OF AUTOMATION WHICH WILL PRODUCE MAJOR IMPROVEMENTS IN THE EFFICIENCY AND PRODUCTIVITY OF THE SYSTEM. WE CAN NO LONGER AFFORD TO SHRINK THE SIZE AND INCREASE THE NUMBER OF ATC SECTORS TO ACCOMMODATE TRAFFIC. AUTOMATION CAN MAKE OUR SYSTEM LESS MANPOWER-INTENSIVE, WHILE AT THE SAME TIME PRODUCING MAJOR EFFICIENCIES.

THE AERA PROGRAM WILL RELY UPON THE AVAILABILITY OF IMPROVED VOICE AND DATA COMMUNICATIONS AND THE AVAILABILITY OF MODE S DATA LINK TO ACHIEVE THESE SIGNIFICANT PRODUCTIVITY SAVINGS.

EARLY FUNCTIONS OF AERA WILL BE CALLED OUT AS A PART OF THE STEP 2 PROCUREMENT TO PROVIDE AUTOMATION TOOLS TO AID THE CONTROLLER IN PREPARING AND ISSUING FUEL EFFICIENT CLEARANCES AND DIRECT ROUTING. STEP 3 FUNCTIONS WILL PERFORM THE MORE COMPLEX FUNCTIONS SUCH AS AUTOMATIC CONFLICT PROBE AND RESOLUTION TO FREE THE CONTROLLERS OF THE WORKLOAD OF THE CRITICAL DETECTION AND RESOLUTION OF CONFLICTS.

DURING 1982, THE FULL AERA DATA PROCESSING REQUIREMENTS WILL BE IDENTIFIED AS AN INPUT TO THE EN ROUTE HOST SPECIFICATION. PREPARATION OF THE SPECIFICATION FOR AERA PACKAGE 1 WILL BE COMPLETED IN 1982. IN FY-1983, WE WILL CONTINUE THE MAN MACHINE EXPERIMENTS AT THE FAA TECHNICAL CENTER. IT IS EXPECTED THAT THE INITIAL FUNCTIONS OF AERA WILL BE AVAILABLE WITH THE INSTALLATION OF THE NEW COMPUTERS STARTING IN THE 1989 TIME FRAME. AERA PACKAGE 2 FUNCTIONS WILL BE DEVELOPED BY 1984, AND IMPLEMENTATION IS PLANNED FOR 1992.

(VIEWGRAPH #17 OFF VIEWGRAPH #18 ON)

ANOTHER KEY FAA PROGRAM IS THE AUTOMATION OF THE NATION'S TRAFFIC FLOW MANAGEMENT SERVICE TO ACHIEVE OPTIMAL AIRPORT THROUGHPUT AND SYSTEMWIDE FUEL SAVINGS FOR THE OPERATORS. AN IMPORTANT PART OF THE PROCESS OF INTEGRATED FLOW MANAGEMENT (THAT IS, IFM) IS THE DEVELOPMENT OF AN AUTOMATED PLANNING CAPABILITY FOR THE TERMINAL THAT WILL CONSIDER THE INTERACTION AND OPERATIONAL INTERRELATIONSHIP OF THE RUNWAY/TAXIWAY SYSTEM AND THE TERMINAL AIRSPACE. IT WILL OPTIMIZE THE ARRIVAL AND DEPARTURE FLOWS THROUGH A DIRECT AUTOMATED

INTERFACE WITH EN ROUTE METERING, THE CENTER DEPARTURE SECTORS AND THE CENTRAL FLOW CONTROL FACILITY. OUR IMMEDIATE ATTENTION TOWARDS ATTAINMENT OF THESE GOALS IS BASED ON THE FINALIZATION OF THE INTEGRATED FLOW MANAGEMENT CONCEPT IN FY-1982 WHICH WILL INCLUDE THE OPERATIONAL DESCRIPTION OF THE COMPONENTS OF A TERMINAL PLANNING AID AS WELL AS THE OPERATIONAL REQUIREMENTS FOR A TERMINAL ARRIVAL PLANNING CAPABILITY. DURING FY-1983 EFFORTS WILL CONTINUE IN THE DEVELOPMENT OF THE TERMINAL PORTION OF IFM. ADDITIONALLY, A REQUIREMENTS AND SIZING ANALYSIS WILL BE PERFORMED FOR A NAS MODEL WHICH COULD BE USED TO PROVIDE DYNAMIC, COMPLETE AND TIMELY INFORMATION ON NATIONAL TRAFFIC FLOWS, LOADINGS, SYSTEM STATUS AND WEATHER.

(VIEWGRAPH #18 OFF   VIEWGRAPH 19 ON)

MODERNIZATION OF OUR HIGH ACTIVITY FLIGHT SERVICE STATIONS (FSS'S) IS ONE OF THE MOST NEEDED PROGRAMS CURRENTLY BEING UNDERTAKEN BY FAA. DEMAND FOR FLIGHT SERVICES IS EXPECTED TO INCREASE BY 79% BETWEEN NOW AND 1993, AND A MAJOR INCREASE IN STAFFING AND FUNDING LEVELS WOULD BE NECESSARY TO MEET THIS DEMAND IF AUTOMATION EFFORTS WERE NOT COMPLETED.

LAST YEAR WE ENTERED INTO A CONTRACT TO AUTOMATE 61 OF OUR LARGEST FSS'S USING F&E FUNDING. PARALLEL R&D EFFORTS CONTINUE TO DEVELOP ENHANCEMENTS TO THAT SYSTEM THAT WILL INCLUDE THE VOICE RESPONSE SYSTEM, AN EXPANDED DIRECT USER-ACCESS TERMINAL FUNCTION, AN AVIATION ROUTE FORECAST FUNCTION, A MASS WEATHER DISSEMINATION SYSTEM, AND PROVISIONS FOR WEATHER DATA TRANSMISSION VIA DATA LINK.

(VIEWGRAPH #19 OFF   VIEWGRAPH #20 ON)

THE MODEL I SYSTEM WHICH WILL AUTOMATE WEATHER AND AERONAUTICAL INFORMATION AND FLIGHT PLAN ENTRY AND PROCESSING AT THE MAJOR FSS'S WILL BE IMPLEMENTED LATER THIS YEAR. THE MODEL II SYSTEM WHICH INCLUDES THE ADDITION OF RETRIEVABLE WEATHER INFORMATION USING AN ALPHANUMERIC GRAPHICS DISPLAY WILL BE IMPLEMENTED IN FY-1986.

MODEL III EFFORTS INCLUDE CONTINUATION OF THE VOICE RESPONSE DEMONSTRATIONS IN WASHINGTON, D.C., AND COLUMBUS, OHIO, AND AWARD OF THE INITIAL FSAS ENHANCEMENTS CONTRACT IN 1983. INITIAL ENHANCEMENTS WILL INCLUDE VOICE RESPONSE SYSTEM SERVICES AND THE USE OF DIRECT USER ACCESS TERMINALS.

(VIEWGRAPH #20 OFF   VIEWGRAPH #21 ON)

I WOULD NOW LIKE TO DISCUSS FAA'S AIRCRAFT SEPARATION ASSURANCE PROGRAM. CONFLICT ALERT AND CONFLICT RESOLUTION WILL CONTINUE TO FUNCTION AS THE PRIMARY SYSTEM FOR ASSISTING CONTROLLERS IN REDUCING SYSTEM ERRORS.

IN ADDITION, THE AVIATION INDUSTRY AND FAA HAVE SOUGHT AN INDEPENDENT AIRBORNE BACKUP TO THE GROUND-BASED ATC SYSTEM TO PROVIDE YET ANOTHER MEASURE OF SAFETY TO PROTECT AGAINST THE RARE EVENT OF ATC SYSTEM ERROR AND PILOT ERROR. AS I MENTIONED EARLIER, THE TCAS I AND TCAS II SYSTEMS HAVE BEEN SELECTED TO PROVIDE THIS INDEPENDENT PROTECTION. I WILL SPEAK IN DEPTH ON TCAS IN THE NEXT FEW SLIDES.

I WOULD ALSO LIKE TO MENTION THAT AN AUTOMATIC TRAFFIC ADVISORY SERVICE (ATAS) IS BEING CONSIDERED FOR POSSIBLE IMPLEMENTATION AT SOME HIGH DENSITY TERMINAL LOCATIONS. THIS SERVICE CAN PROVIDE GROUND DERIVED TRAFFIC ADVISORIES TO EQUIPPED AIRCRAFT USING THE MODE S DATA LINK; THEREBY ENHANCING SYSTEM SAFETY AND INCREASING PRODUCTIVITY.

(VIEWGRAPH #21 OFF   VIEWGRAPH #22 ON)

AS YOU KNOW, TCAS EQUIPMENTS WILL OPERATE THROUGHOUT THE AIRSPACE WITHOUT DEPENDENCE ON GROUND EQUIPMENTS AND WILL OPERATE COMPATIBLY IN THE CURRENT AND FUTURE ATC SYSTEM. TCAS ALSO USES THE MODE S MESSAGE FORMAT TO INSURE FUTURE COMPATIBILITY WITH THE INTERNATIONALLY STANDARDIZED SECONDARY SURVEILLANCE RADAR (SSR).

VARIOUS LEVELS OF COLLISION PROTECTION WILL BE AVAILABLE FROM TCAS EQUIPMENTS. THE LEAST EXPENSIVE TCAS I OPTION, INTENDED FOR INSTALLATION IN SMALL GENERAL AVIATION AIRCRAFT, WILL PROVIDE AN ALERT TO THE PILOT INDICATING THAT AN INTRUDING AIRCRAFT IS IN THE NEAR VICINITY. IN ADDITION, TCAS I EQUIPMENT CAN DISPLAY THE POSITION AND MANEUVER INTENTION OF TCAS II AIRCRAFT. THE MORE SOPHISTICATED TCAS II UNIT WOULD BE CAPABLE OF NOT ONLY PROVIDING AN ALERT THAT AN AIRCRAFT IS NEARBY BUT WOULD ALSO INDICATE THE RELATIVE POSITION OF THE INTRUDER BY DISPLAYING A TRAFFIC ADVISORY

AND COORDINATED RESOLUTION ADVISORY ON A COCKPIT DISPLAY. THE MORE EXPENSIVE TCAS II WILL PROVIDE THE MAXIMUM PROTECTION IN ALL AIRSPACE.

(VIEWGRAPH #22 OFF   VIEWGRAPH #23 ON)

TCAS II IS A FULL-CAPABILITY SYSTEM INTENDED FOR INSTALLATION IN AIR TRANSPORTS AND SOPHISTICATED GENERAL AVIATION AIRCRAFT. TCAS II IS FURTHER DISTINGUISHED AS EITHER THE "MINIMUM" TCAS II OR THE "ENHANCED" TCAS II. THE "MINIMUM" TCAS II CAN PROVIDE:

-- CLIMB/DESCEND RESOLUTION ADVISORIES IN HIGH DENSITY AIRSPACE.

-- PROXIMITY WARNING INDICATIONS OF NEARBY AIRCRAFT TO INCLUDE THE BEARING OF THE INTRUDING AIRCRAFT.

-- CROSSLINK TRAFFIC AND MANEUVER ADVISORIES TO TCAS I EQUIPPED AIRCRAFT TO ALLOW SAFE MANEUVERING BETWEEN TCAS I AND TCAS II EQUIPPED AIRCRAFT.

-- ASSURANCE THAT SIGNALS TRANSMITTED BY TCAS II AVIONICS DO NOT DEGRADE THE ABILITY OF THE GROUND-BASED ATC RADARS TO SENSE TRAFFIC.

THE "ENHANCED" TCAS II SYSTEM WILL BE ABLE TO GENERATE RIGHT AND LEFT TURN ADVISORIES.

(VIEWGRAPH #23 OFF VIEWGRAPH #24 ON)

TCAS I PROVIDES A LIMITED SET OF TRAFFIC ADVISORY SERVICES AND INCLUDES AN INTEGRAL MODE S TRANSPONDER WHICH ENHANCES GROUND SURVEILLANCE, AND PERMITS A SMALL GENERAL AVIATION AIRCRAFT TO BE SEEN BY A NEARBY TCAS II AIRCRAFT.

TCAS I ALSO HAS THE ABILITY TO RECEIVE AND DISPLAY THE MODE S ADVISORIES CROSSLINKED BY TCAS II EQUIPPED AIRCRAFT. FINALLY, TCAS I HAS THE ABILITY TO SENSE THE PRESENCE OF NEARBY AIRCRAFT BY PASSIVELY LISTENING TO THEIR TRANSPONDERS' REPLIES.

(VIEWGRAPH #24 OFF VIEWGRAPH #25 ON)

THE SCHEDULE FOR TCAS DEVELOPMENT WILL RESULT IN TCAS I AVIONICS BECOMING AVAILABLE FOR INSTALLATION IN 1983 AND TCAS II IN 1984.

(VIEWGRAPH #25 OFF VIEWGRAPH #26 ON)

FAA HAS COMPLETED THE DEVELOPMENT OF THE DISCRETE ADDRESSING FUNCTION OF THE ATC RADAR BEACON SYSTEM, CALLED MODE S, WHICH WILL PROVIDE IMPORTANT IMPROVEMENTS IN AIR TRAFFIC CONTROL SECONDARY RADAR SURVEILLANCE AND AN INTEGRAL DATA LINK CAPABILITY. THE OPERATIONAL DEPLOYMENT OF MODE S BEGINNING IN FY-1986 IS AN IMPORTANT ELEMENT OF OUR FUTURE AUTOMATION EFFORTS AND KEY TO FUTURE PRODUCTIVITY SAVINGS WHICH WILL BE ACCRUED WITH THE IMPLEMENTATION OF AERA FUNCTIONS.

FAA'S DATA LINK PROGRAM IS AIMED AT EXTENDING THE BENEFITS OF AUTOMATION TO THE COCKPIT, PROVIDING DIRECT USER ACCESS TO AUTOMATED DATA BASES USING A COCKPIT KEYBOARD, LOWERING CONTROLLER AND PILOT WORKLOAD AND ENHANCING SAFETY. DATA LINK SERVICES WILL BE IMPLEMENTED IN PACKAGES:

-- PACKAGE I INCLUDES A SECTOR HANDOFF SERVICE TO AUTOMATICALLY ALERT AIRCRAFT OF ASSIGNED ALTITUDE, NEW COMMUNICATIONS FREQUENCY AND THE NEXT WAYPOINT. DEVELOPMENT OF PACKAGE I SERVICE WILL BE INITIATED IN FY-1983 AND IS EXPECTED TO BE AVAILABLE IN FY-1987.

--PACKAGE II SERVICES INCLUDE WEATHER PRODUCTS, ALTITUDE ASSIGNMENT CONFIRMATION, MINIMUM SAFE ALTITUDE WARNING AND CLEARANCE DELIVERY. PACKAGE II SERVICES WILL BE AVAILABLE IN FY-1988.

--PACKAGE III WILL INCLUDE ADDITIONAL WEATHER AND ATC PRODUCTS.

(VIEWGRAPH #26 OFF VIEWGRAPH #27 ON)

THE MODE S TRANSPONDER CAN PROVIDE THE CAPABILITY FOR DATA LINK COMMUNICATIONS TO AND FROM THE GROUND. THAT CAPABILITY ALONG WITH THE AVAILABILITY OF A SURVEILLANCE DATA BASE USED BY THE AIR TRAFFIC CONTROL SYSTEM PERMITS THE DEVELOPMENT OF AN AUTOMATED TRAFFIC ADVISORY SERVICE (THAT IS, ATAS). SUCH A SERVICE WOULD AUTOMATE THE FUNCTION NOW PROVIDED BY AIR TRAFFIC CONTROLLERS, ON A WORKLOAD PERMITTING BASIS, CALLING TO PILOTS' ATTENTION INFORMATION OF TRAFFIC OF CONCERN WHO MAY OR MAY NOT BE FULL PARTICIPANTS IN THE

ATC SYSTEM. THIS DATA LINK APPLICATION CAN PROVIDE GOUND-DERIVED TRAFFIC ADVISORIES PRIMARILY IN HIGH TRAFFIC AREAS AS WELL AS TERRAIN, OBSTACLE, AND RESTRICTED AIRSPACE ADVISORIES TO EQUIPPED AIRCRAFT. A DRAFT ATAS NATIONAL STANDARD WILL BE AVAILABLE LATER THIS YEAR.

(VIEWGRAPH #27 OFF   VIEWGRAPH #28 ON)

INCLUDED IN THE NAS PLAN IS A PROGRAM TO IMPROVE THE QUALITY OF WEATHER DATA AVAILABLE TO PILOTS AND CONTROLLERS. THE WEATHER PROGRAM ENCOMPASSES THREE MAJOR DEVELOPMENT AREAS:

(1) DEVELOPMENT OF AN IMPROVED NATIONAL SYSTEM FOR DETECTING HAZARDOUS WEATHER PHENOMENA THROUGH THE APPLICATION OF DOPPLER RADAR TECHNOLOGY (NEXRAD); (2) ENHANCEMENTS TO THE WEATHER DATA BASES OF THE ATC SYSTEM TO PROVIDE PILOTS AND CONTROLLERS WITH THE CAPABILITY FOR RAPID ACCESS TO HAZARDOUS AND ROUTINE WEATHER INFORMATION; AND (3) DEVELOPMENT OF GROUND-BASED AUTOMATED WEATHER OBSERVATION SYSTEMS TO PROVIDE OBSERVATIONS AT LOCATIONS WHERE NEEDED; SUCH AS, AIRPORTS WITH APPROVED INSTRUMENT APPROACHES, HELIPORTS, AND OFFSHORE DRILLING PLATFORMS.

FAA RESEARCH ACTIVITIES IN THESE AREAS ARE MONITORED BY THE FEDERAL COORDINATOR FOR METEOROLOGICAL SERVICES AND SUPPORTING RESEARCH. THIS OFFICE COORDINATES THE ACTIVITIES OF ALL AGENCIES HAVING WEATHER RELATED MISSIONS AND ACTIVITIES, INCLUDING FAA'S AVIATION WEATHER PROGRAMS RELATED TO AVIATION

SAFETY AND THE EFFICIENT USE OF AIRSPACE. THE FAA PROVIDES A REPRESENTATIVE TO THE OFFICE OF THE FEDERAL COORDINATOR WHO ENSURES COMPREHENSIVE WEATHER PLANNING ON A NATIONAL LEVEL.

(VIEWGRAPH #28 OFF VIEWGRAPH #29 ON)

TO PROVIDE WEATHER RADAR SERVICES, FAA IS WORKING WITH DOD AND DOC TO ESTABLISH AN AVIATION WEATHER RADAR NETWORK THAT WILL PROVIDE ACCURATE HAZARDOUS AVIATION WEATHER PRODUCTS. A NEW DOPPLER WEATHER RADAR SYSTEM (NEXRAD) WILL BE DEVELOPED TO PROVIDE REAL-TIME WEATHER DATA FOR ATC FUNCTIONS IN EN ROUTE AIRSPACE AND IN SOME TERMINAL AIRSPACE. SHOULD THE PLANNED DEPLOYMENT OF NEXRAD RADARS NOT BE ADEQUATE TO MEET THE HIGH DENSITY TERMINAL WEATHER DATA REQUIREMENT, FAA MAY INITIATE DEVELOPMENT OF A TERMINAL DOPPLER WEATHER RADAR TO OBTAIN ACCURATE REAL-TIME PRECIPITATION, TURBULENCE, AND WIND SHEAR DATA FOR THE AIRPORT/TERMINAL AREA.

AWARDS OF MULTIPLE SYSTEM DESIGN CONTRACTS WILL BE MADE IN 1982. RESULTS OF THIS ACTIVITY WILL BE USED IN AWARDING THE VALIDATION PHASE CONTRACTS IN FY-1983. INITIAL IMPLEMENTAION OF NEXRAD IS PLANNED FOR FY-1987.

(VIEWGRAPH #29 OFF VIEWGRAPH #30 ON)

A CENTER WEATHER PROCESSOR WILL BE DEVELOPED AS PART OF THE CENTER WEATHER SERVICE METEOROLOGICAL POSITION SYSTEM TO ACHIEVE REAL-TIME DISSEMINATION OF HAZARDOUS WEATHER INFORMATION TO AIR TRAFFIC CONTROLLERS, PILOTS AND FLIGHT SERVICE SPECIALISTS AT EN ROUTE

SECTORS, TRACONS, TOWER CABS, AND FSS'S. THIS IS INTENDED TO IMPROVE THE CAPABILITY OF THE SYSTEM TO COPE WITH AND ADVISE PILOTS OF HAZARDOUS WEATHER CONDITIONS. THESE IMPROVEMENTS IN THE COLLECTION AND DISTRIBUTION OF WEATHER INFORMATION ARE NEEDED TO REDUCE THE NUMBER OF WEATHER-RELATED ACCIDENTS AND AIR TRAFFIC DELAYS CAUSED BY WEATHER. THESE EFFORTS ARE DIVIDED INTO THREE PHASES. PHASE I ACTIVITY INCLUDES AUTOMATING THE CENTER WEATHER SERVICE UNIT WORKSTATION AND PROVIDING THE CAPABILITY TO DISSEMINATE DATA TO ATC SYSTEMS. IN FY-1982 WE WILL COMPLETE THE ENGINEERING REQUIREMENTS FOR THE CENTER WEATHER PROCESSOR; AND, IN FY-1983, FAA WILL ISSUE THE REQUEST FOR PROPOSALS TO DEVELOP THE PROCESSOR. IMPLEMENTATION OF THE CENTER WEATHER PROCESSOR WILL BE IN FY-1985.

PHASE II EFFORTS WILL PROVIDE THE CAPABILITY TO PROVIDE WEATHER CONTOURS ON THE CONTROLLER'S DISPLAY AND THIS ENHANCEMENT SHOULD BE READY FOR IMPLEMENTATION IN FY-1985.

PHASE III WORK IS RELATED TO INTERFACING NEXRAD WITH THE CENTER WEATHER PROCESSOR AND WILL BE COMPLETED IN TIME FOR THE IMPLEMENTATION OF NEXRAD IN FY-1987.

(VIEWGRAPH #30 OFF VIEWGRAPH #31 ON)

EFFECTIVE COMMUNICATION IS, OF COURSE, THE BACKBONE OF THE AVIATION SYSTEM. FAA INTENDS TO MAKE A MAJOR CHANGE IN ITS COMMUNICATIONS SYSTEM, ESPECIALLY IN THE DATA COMMUNICATIONS THAT ARE NEEDED TO ACHIEVE THE BENEFITS OF NETWORKING AND TRUNKING IN ORDER TO REDUCE COSTS AND IMPROVE SERVICE.

FAA WILL BE ESTABLISHING A NATIONAL AIRSPACE DATA INTERCHANGE NETWORK (THAT IS, NADIN) BETWEEN 1981 AND 1985. IT WILL FORM THE NUCLEUS OF AN FAA DATA NETWORK. IT WILL REPLACE MULTIPLE LOW-SPEED LINES WITH CONCENTRATORS, SWITCHES, AND HIGH-SPEED LINES. ENHANCEMENTS TO THIS INITIAL NADIN NETWORK WILL BE NEEDED TO MEET THE DATA TRANSFER REQUIREMENTS OF OTHER MAJOR FAA PROGRAMS AND FUNCTIONS; FOR EXAMPLE, COMMUNICATION BETWEEN CENTER COMPUTERS, CENTER AND TERMINAL COMPUTERS, THE REMOTE MAINTENANCE MONITORING SYSTEM, THE ADVANCED WEATHER SYSTEM, THE FACILITY CONSOLIDATION EFFORT, AND THE COMMUNICATION REQUIRED FOR THE AIR-TO-GROUND MODE S DATA LINK OPERATION. IN FY-1982 THE DESIGN OF THE REMOTE MAINTENANCE MONITORING INTERFACE WILL BE COMPLETED. IN FY-1983 THE DESIGN OF THE SYSTEM TO TRANSFER DATA BETWEEN CENTERS WILL BE COMPLETED.

(VIEWGRAPH #31 OFF VIEWGRAPH #32 ON)

DEVELOPMENT IS REQUIRED ON A MODERNIZED VOICE SWITCHING AND CONTROL SYSTEM (THAT IS, VSCS) TO SUPPORT FLEXIBLE OPERATIONS AT NEW AND CONSOLIDATED AIR ROUTE TRAFFIC CONTROL CENTERS, TO REDUCE LEASED LINE AND EQUIPMENT COSTS, ENHANCE CONTROLLER PRODUCTIVITY, AND PERMIT THE EVENTUAL TRANSMISSION OF VOICE AND DATA OVER AN AERONAUTICAL SATELLITE-BASED SYSTEM. THE VSCS SYSTEM WILL BECOME AN INTEGRAL PART OF THE ADVANCED AUTOMATION SYSTEM AND WILL PROVIDE AUTOMATIC SWITCHING OF COMMUNICATIONS CHANGES TO MATCH CHANGING SECTOR AIRSPACE COVERAGE. IN FY-1982, THE VSCS SPECIFICATION WILL

BE DEVELOPED. IN FY-1983 THE REQUEST FOR PROPOSALS WILL BE ISSUED AND A CONTRACT AWARDED FOR THE NEW USES IN FY-1984. THE NEW SYSTEM WILL BE AVAILABLE IN FY-1987.

(VIEWGRAPH #32 OFF   VIEWGRAPH #33 ON)

OUR E&D NAVIGATION PROGRAM ENCOMPASSES TWO MAJOR ACTIVITY AREAS. THE FIRST ADDRESSES NEAR TERM ITEMS SUCH AS SUSTAINING ENGINEERING ON VOR DME, NDB, ILS, AND ESTABLISHING CERTIFICATION CRITERIA FOR SUPPLEMENTAL RNAV SYSTEMS INCLUDING LORAN-C AND OMEGA. THE OTHER PROGRAM AREA INCLUDES THE ACTIVITIES NEEDED TO SUPPORT THE ELEMENTS OF THE RADIONAVIGATION SYSTEM THIS PROGRAM IS BEING CONDUCTED IN SUPPORT OF THE FRP (THAT IS, FEDERAL RADIONAVIGATION PLAN) WHICH IS A JOINT DOT/DOD EFFORT. (THE FRP IS REVISED ANNUALLY, AND THE 1982 EDITION WILL BE AVAILABLE IN THE LATE SPRING.)

THE FAA IS ASSESSING VORTAC, LORAN-C, AND NAVSTAR GPS AS THE PRIME ELEMENTS OF THE PROPOSED SYSTEM MIX. THE APPROACH BEING TAKEN IS TO ASSESS AND COMPARE THE INSTITUTIONAL, ECONOMIC, AND TECHNICAL PERFORMANCE OF EACH SYSTEM AND SYSTEM MIXES. BECAUSE OF THE UNIQUE POTENTIAL OF NAVSTAR GPS SPECIAL EMPHASIS IS BEING PLACED ON ITS EVALUATION. THE FAA PRELIMINARY RECOMMENDATION FOR THE FUTURE SYSTEM MIX WILL BE DEVELOPED BY THE END OF 1982. A JOINT DOT/DOD PRELIMINARY RECOMMENDATION WILL BE AVAILABLE BY THE END OF 1983, AND A FINAL JOINT DOT/DOD RECOMMENDATION WILL BE MADE IN 1986.

(VIEWGRAPH #33 OFF   VIEWGRAPH #34 ON)

THE FAA HAS BEEN INVOLVED IN THE EVALUATION OF NAVSTAR/GPS FOR CIVIL AVIATION USE SINCE 1979 UTILIZING A LOANED MILITARY "Z" SET. RESULTS OF TESTS TO DATE CONFIRM THE OUTSTANDING ACCURACY PERFORMANCE OF THE UNDEGRADED SIGNAL. HOWEVER ANALYSIS HAS IDENTIFIED SEVERAL PROBLEM AREAS FOR CIVIL AVIATION USE OF NAVSTAR GPS. ONE OF THESE IS THAT THE CURRENT 18 SATELLITE CONSTELLATION DOES NOT PROVIDE 5 SATELLITES IN VIEW IN PROPER GEOMETRY AT ALL TIMES WHICH IS THE MINIMUM COVERAGE NECESSARY TO EQUAL THE CURRENT VOR PERFORMANCE AND PROVIDE BACKUP FOR SATELLITE FAILURE. ANOTHER TECHNICAL CONSIDERATION UNRESOLVED IS THE INTEGRITY OF THE NAVIGATION INFORMATION PRESENTED TO THE PILOT. IT TAKES TIME BEFORE AN ERROR/MALFUNCTION IS DETECTED AND THE PILOT MADE AWARE OF IT.

OUR INITIAL COST ANALYSIS SHOWED THAT NAVSTAR GPS IS THE MOST EXPENSIVE OF THE PROPOSED SYSTEMS FOR CIVIL AVIATION. HOWEVER, DOT IS NOW INVOLVED IN A MULTIMODAL COST ANALYSIS TO UPDATE THE EARLIER WORK. RESULTS OF THIS ANALYSIS IS DUE IN THE LATE SPRING (MAY 1982).

THERE ARE MANY INSTITUTIONAL ISSUES WITH PROPOSING A DOD SYSTEM FOR DOMESTIC USE. ONE IS THE CONTROL OF THE SYSTEM, IN TERMS OF BOTH ACCURACY LEVEL AND AVAILABILITY. CURRENTLY THE PROPOSED ACCURACY THAT DOD WILL PROVIDE IN 1989 IS 500 METERS (WITH 95 PERCENT PROBABILITY), WHICH DOES NOT MEET THE ACCURACY REQUIREMENTS FOR ALL NAVIGATION SERVICES IN CIVIL AVIATION. ANOTHER ISSUE THAT IS CURRENTLY BEING STUDIED IS COST RECOVERY FOR THE NAVSTAR GPS

PROGRAM. THE USUAL METHOD OF COST RECOVERY FOR AVIATION USERS HAS BEEN SOME TYPE OF USER TAX. THIS HAS WORKED FINE FOR DOMESTIC SYSTEMS, BUT NAVSTAR GPS WILL BE INTERNATIONAL WHICH RAISES A DIFFERENT PROBLEM. ALTHOUGH FAA CURRENTLY HAS NO VIABLE SOLUTION FOR THE NAVSTAR GPS COST RECOVERY ISSUE, A FEW COMMENTS ARE IN ORDER. ALTHOUGH THE CURRENT 18 SATELLITE SYSTEM WITH DEGRADED SIGNAL ACCURACY DOES NOT APPEAR TO MEET THE ACCURACY AND RELIABILITY REQUIREMENTS OF CIVIL AVIATION, AN IMPROVED VERSION OF THE SYSTEM COULD BE CONSIDERED AS A POTENTIAL REPLACEMENT FOR VOR DME. THE SERVICE, HOWEVER, MUST BE AVAILABLE TO CIVIL AVIATION AT A COST THAT IS NO HIGHER THAN THEY NOW PAY FOR THE CURRENT SERVICE. ALTHOUGH NAVSTAR GPS HAS THE POTENTIAL OF PROVIDING ADDITIONAL SERVICES, THE VALUE OF THESE SERVICES IS NOT KNOWN AND MANY OF THE USERS MAY NOT NEED OR DESIRE THEM. THEREFORE, COST RECOVERY PROPOSALS FOR NAVSTAR GPS MUST BE CONSIDERED IN LIGHT OF TOTAL SERVICES PROVIDED TO ALL USERS--MILITARY, CIVIL, AND INTERNATIONAL.

(VIEWGRAPH #34 OFF VIEWGRAPH #35 ON)

FLIGHT TESTS AND ANALYSIS OF THE OPERATIONAL SUITABILITY OF NAVSTAR GPS FOR CIVIL AVIATION WERE COMPLETED IN FY-1982. FLIGHT TESTING WILL BE EXTENDED INTO FY-1983 TO INCLUDE AN OPERATIONAL SUITABILITY EVALUATION OF THE LOW COST EXPERIMENTAL GENERAL AVIATION RECEIVER BUILT BY LINCOLN LABORATORY. AS I MENTIONED PREVIOUSLY, FAA WILL MAKE ITS RECOMMENDATION ON THE FUTURE ROLE OF GPS IN FY-1982. DURING FY-1984 AND FY-1985 FAA PLANS TO CONTINUE ITS EVALUATION OF GPS FOR CIVIL APPLICATIONS TO COLLECT DATA AND DEVELOP PROCEDURES NEEDED TO DEFINE THE POTENTIAL OF GPS AS A CIVIL OPERATING SYSTEM.

(VIEWGRAPH #35 OFF VIEWGRAPH #36 ON)

THE DEVELOPMENT ACTIVITIES ASSOCIATED WITH MLS ARE ESSENTIALLY COMPLETE. OUR CURRENT EFFORTS ARE GEARED TO OBTAINING INTERNATIONAL APPROVAL OF STANDARDS AND RECOMMENDED PRACTICES (SARPS) FOR THE PRECISION VERSION OF THE INTERNATIONALLY STANDARDIZED DISTANCE MEASURING EQUIPMENT (DME). THE PREPARATION OF DRAFT PRECISION DME SARPS WAS COMPLETED IN FY-1982 AND THE ALL-WEATHER OPERATIONS PANEL IS EXPECTED TO APPROVE THEM IN FY-1983, WITH FULL ICAO APPROVAL SCHEDULED FOR FY-1984. WE EXPECT OPERATIONAL IMPLEMENTATION OF MLS TO BEGIN IN 1985.

(VIEWGRAPH #36 OFF VIEWGRAPH #37 ON)

ADDITIONAL WORK CONTINUES IN THE DEVELOPMENT OF PROCEDURES AND OPERATIONAL GUIDELINES FOR MLS USE, PARTICULARLY IN ITS USE WITH MORE COMPLEX CURVED APPROACHES. SERVICE TEST AND DEMONSTRATION FLIGHT TEST ACTIVITIES WILL CONTINUE AT WASHINGTON NATIONAL, PHILADELPHIA INTERNATIONAL, AND CLARKSBURG AIRPORTS FROM NOW UNTIL THE END OF 1983 TO DEVELOP THESE PROCEDURES AND OPERATIONAL GUIDELINES. THE FINAL OPERATIONAL EVALUATION REPORTS WILL BE ISSUED IN FY-1984.

(VIEWGRAPH #37 OFF VIEWGRAPH #38 ON)

THE GENERAL OBJECTIVE OF THE AIRPORT R&D PROGRAM IS TO IMPROVE THE SAFETY AND INCREASE THE CAPACITY OF OUR AIRPORT SYSTEM. THE FEDERAL GOVERNMENT HAS IN THE PAST AND WILL CONTINUE TO FOSTER AIRPORT DEVELOPMENT BY PROVIDING SPECIFICATIONS AND ADVISORY MATERIAL FOR APPLICATION IN AIRPORT PLANNING AND CONSTRUCTION PROJECTS. PRODUCTS OF THE FAA AIRPORT R&D PROGRAM, REFLECTING THE MOST CURRENT STATE-OF-THE ART TECHNOLOGY, ARE THE BASIS FOR THE DEVELOPMENT OF AIRPORT STANDARDS AND PROVIDE RECOMMENDATIONS AND TECHNICAL GUIDANCE TO AIRPORT PLANNING CONSULTANTS, AIRPORT MANAGEMENTS AND AIRLINES IN THE DESIGN, CONSTRUCTION AND OPERATION OF COST-EFFECTIVE AND SAFE AIRPORTS.

THE MAJOR AIRPORT RESEARCH ACTIVITIES ARE CONDUCTED IN THE AREAS OF RUNWAY TRACTION; MARKING, LIGHTING AND VISUAL AIDS; AND AIRPORT PAVEMENT.

IN THE AREA OF TRACTION IN FY-1982, WE WILL COMPLETE A STUDY DETAILING THE DRAINAGE CHARACTERISTICS OF VARIOUS RUNWAYS SURFACES AND FINISHES INCLUDING DIFFERENT TYPES OF CONFIGURATION. THE INFORMATION IS ESSENTIAL TO THE DEVELOPMENT OF METHODS AND TECHNIQUES NEEDED TO PREVENT AIRCRAFT HYDROPLANING ON WET OR SLIPPERY SURFACES.

WE WILL ALSO COMPLETE A STUDY WHICH WILL ESTABLISH THE EXTENT AND SEVERITY OF THE PROBLEMS CAUSED BY RUBBER BUILDUP ON POROUS FRICTION COURSE ASPHALTIC CONCRETE.

IN FY-1983 A FINAL REPORT CHARACTERIZING THE EFFECTS OF A WIDE VARIETY OF RUNWAY SURFACE TREATMENTS ON HYDROPLANING WILL BE COMPLETED.

IN THE AREA OF LIGHTING IN FY-1983, WE WILL PUBLISH A REPORT DOCUMENTING TEST AND EVALUATION RESULTS ON THE PRECISION APPROACH PATH INDICATOR (PAPI). THIS PAPI SYSTEM HAS PREVIOUSLY GEEN DESIGNATED BY ICAO AS THE INTERNATIONAL VISUAL APPROACH STANDARD AND COULD BE A CANDIDATE TO REPLACE EXISTING VASI SYSTEMS

IN FY-1984 WE WILL ALSO COMPLETE A REPORT OUTLINING THE TEST AND EVALUATION OF A LOW COST LIGHTING AND MARKING SYSTEM FOR UNPAVED GENERAL AVIATION AIRPORTS.

IN THE PAVEMENT AREA, A JOINT FIVE-YEAR PROGRAM WITH THE FEDERAL HIGHWAY ADMINISTATION AND THE DEPARTMENT OF DEFENSE WILL BE COMPLETED IN FY-1983 ESTABLISHING THE METHODS OF TESTING AND DESIGNING PAVEMENTS TO REDUCE THE EFFECTS OF FREEZE/THAW CYCLES ON RUNWAY STRENGTH. WE WILL COMPLETE THE CHARACTERIZATION OF VARIOUS NONWOVEN ENGINEERING FABRICS TO ENABLE US TO PROVIDE DEFINITIVE GUIDANCE ON USE OF THESE MATERIALS IN RUNWAY CONSTRUCTION BY FY-1984. THIS DESIGN WILL PREVENT OR RETARD SURFACE CRACKING.

IN FY-1984 WE WILL ALSO COMPLETE AND MAKE AVAILABLE TO AIRPORT DESIGNERS, UPDATED CRITERIA FOR RUNWAY OVERLAYS USING CURRENT AIRCRAFT LOADING DATA.

(VIEWGRAPH #38 OFF VIEWGRAPH #39 ON)

I WOULD NOW LIKE TO DISCUSS FAA'S ADVANCED DEVELOPMENT PROGRAM. ADVANCED CONCEPT RESEARCH AND EXPLORATION IS NEEDED TO KEEP FAA IN THE FOREFRONT OF TECHNOLOGY AND TO ASSURE READINESS TO EMBRACE NEW IDEAS AND NEW CONCEPTS WHICH MAY IMPROVE THE NATIONAL AIRSPACE SYSTEM. I WOULD LIKE TO DISCUSS SEVERAL ITEMS OF OUR ADVANCED CONCEPT EFFORTS WHICH WE CURRENTLY HAVE UNDERWAY.

- THERE IS A NEED TO EVALUATE THE UTILIZATION OF NEW SENSOR TECHNOLOGY FOR DEVELOPING A PRACTICAL SOLUTION TO THE WAKE VORTEX PROBLEM. EVALUATION OF THE FM-CW PULSED DOPPLER RADAR WILL BE COMPLETED IN FY-1982. SENSOR TECHNOLOGY EXPLORATIONS WHICH MAY HAVE AN APPLICATION TO DETECT AND ACTIVELY TRACK THE WAKE VORTICES WILL CONTINUE, ASSUMING SUCCESSFUL DEVELOPMENT OF A SENSOR, WE HOPE TO HAVE AN ADVANCED VORTEX SYSTEM DETECTION AND AVOIDANCE CONCEPT DESIGN BY FY-1986. THIS WILL LEAD TO AN ENGINEERING SPECIFICATION FOR AN ADVANCED VORTEX SYSTEM IN FY-1990.

(VIEWGRAPH #39 OFF VIEWGRAPH #40 ON)

- WE HAVE CONDUCTED AN AGRESSIVE PROGRAM TO IMPROVE AIRPORT CAPACITY FOR A NUMBER OF YEARS NOW. WE HAVE COMPLETED AIRPORT AND AIRSPACE CAPACITY AND DELAY MODEL DEVELOPMENT AND HAVE COMPLETED CAPACITY AND DELAY STUDIES FOR MANY OF OUR HIGH DENSITY AIRPORTS. CURRENT EFFORTS INCLUDE INVESTIGATION OF THE FEASIBILITY OF ESTABLISHING SEPARATE SHORT RUNWAYS FOR

GENERAL AVIATION AND COMMUTER OPERATORS, DEVELOPMENT OF INNOVATIVE PARALLEL IFR APPROACH PROCEDURES, REDUCTION OF PARALLEL RUNWAY SPACING REQUIREMENTS AND ASSOCIATED OPERATIONAL PROCEDURES, AND THE DEVELOPMENT OF A RUNWAY CONFIGURATION SELECTION COMPUTER THAT PROVIDES THE HIGHEST AIRPORT CAPACITY FOR ANY WIND AND WEATHER CONDITION.

PLANNED FY-1982 ACCOMPLISHMENTS INCLUDE COMPLETING SIMULATION TEST PLANS FOR CLOSELY-SPACED INDEPENDENT PARALLEL APPROACHES, AND CONTINUING TECHNOLOGY INVESTIGATIONS TO IDENTIFY OTHER MEANS TO IMPROVE AIRPORT CAPACITY. IN FY-1984 THE RUNWAY OCCUPANCY TIME STUDY REVIEW AND ASSESSMENT WILL ALSO BE COMPLETED AND WILL BE USED AS INPUT FOR IMPROVING DEMAND MANAGEMENT AT CONGESTED HUB AIRPORTS.

- HUMAN LIMITATIONS CONSTITUTE A MAJOR CAUSE OF ACCIDENTS AND ERRORS TODAY. FUTURE SYSTEMS MUST BE HUMAN-ERROR TOLERANT AND PROVIDE THE PROPER ALLOCATION OF FUNCTIONS BETWEEN MAN AND MACHINE. OUR HUMAN FACTORS PROGRAM IS AIMED AT SYSTEM PERFORMANCE ENHANCEMENT AND ERROR REDUCTION, BOTH IN THE COCKPIT AND ON THE GROUND.

MAJOR EFFORTS INCLUDE THE DEVELOPMENT AND INVESTIGATION OF BASIC HUMAN FACTORS TECHNOLOGY TO RESOLVE MAN-MACHINE PROBLEMS IN AVIATION SYSTEMS, TO IDENTIFY REQUIREMENTS FOR HUMAN FACTORS RESEARCH, AND STUDIES TO IDENTIFY AND RESOLVE HUMAN FACTOR PROBLEMS IN THE FUTURE AVIATION SYSTEM. OUR HUMAN FACTORS ACTIVITY IS BEING CONDUCTED JOINTLY WITH NASA AND

DOD. THE EXPERIMENTS TO BE CONDUCTED WILL UTILIZE HUMAN FACTOR LABORATORIES LOCATED AT NASA AMES, NASA LANGLEY, WRIGHT PATTERSON FLIGHT DYNAMIC LABORATORY, AND THE FAA TECHNICAL CENTER AND WILL CONSIDER COCKPIT AND CONTROLLER ENVIRONMENTS. FAA'S NEAR TERM ACTIVITIES WILL BE AIMED AT DETERMINING THE MAN-MACHINE REQUIREMENTS OF THE NEW ADVANCED COMPUTER SYSTEM, INCLUDING OPERATING WITH THE NEW SECTOR SUITE AND THE MORE ADVANCED AERA FUNCTIONS.

- WE MUST ASSURE THAT FUTURE SYSTEMS WITH HIGH LEVELS OF AUTOMATION, SUCH AS OUR ADVANCED COMPUTER SYSTEM USE RELIABLE, FAULT-TOLERANT HARDWARE AND SOFTWARE TECHNOLOGY TO MINIMIZE THE DISRUPTIONS IN THE ATC SYSTEM.

BY FY-1983, WE WILL HAVE DEVELOPED FAULT-TOLERENCE PERFORMANCE CRITERIA FOR THE COMPUTER REPLACEMENT PROGRAM. BY 1986, FAA WILL HAVE DEVELOPED FAULT-TOLERANCE IMPROVEMENTS FOR OUR VARIOUS AIR AND GROUND SUBSYSTEMS.

(VIEWGRAPH #40 OFF VIEWGRAPH #41 ON)

- INVESTIGATION OF INTELLIGENT COMPUTER SYSTEMS TO ASSUME MORE OF THE MANUAL ATC DECISION MAKING PROCESS WILL CONTINUE. IN FY-1982 AND FY-1983 RESEARCH WILL BE CONDUCTED INTO THE FEASIBILITY OF SELECTED COMPUTER-AIDED DECISIONMAKING TECHNIQUES FOR USE IN ATC AND COCKPIT SYSTEMS WITH SPECIAL EMPHASIS ON THE INFORMATION REQUIREMENTS NECESSARY TO ASSURE THAT THE SYSTEM IS PROPERLY FUNCTIONING.

- OUR SATELLITE APPLICATIONS PROGRAM IS LOOKING FOR WAYS TO IMPROVE ATC SYSTEM PERFORMANCE USING SATELLITE TECHNOLOGY.

  WE ARE LOOKING AT SATELLITE SYSTEMS TO SATISFY FUTURE CONUS ATC FUNCTIONAL REQUIREMENTS IN A MANNER THAT IS COMPATIBLE WITH THE ANTICIPATED EVOLUTION OF THE GROUND-BASED SYSTEM. SPECIFICALLY, WE WILL INVESTIGATE THE FEASIBILITY OF USING MODE S IN CONJUNCTION WITH SATELLITES AS A BASIS FOR THE FUTURE ATC SURVEILLANCE SYSTEM AND THE TECHNICAL AND OPERATIONAL CHARACTERISTICS OF A SPACE-BASED SURVEILLANCE SYSTEM.

- OUR CURRENT COCKPIT SYSTEMS INTEGRATION PROGRAM IS LOOKING AT FINDING BETTER WAYS TO DISPLAY INFORMATION TO PILOTS IN THE COCKPIT. FAA IS CURRENTLY EVALUATING THE USE OF CDTI AS AN AID TO THE PILOT IN ACHIEVING A BETTER AWARENESS OF THE ATC SITUATION.

  THE FIRST STUDY IS THE USE OF CDTI AS A PILOT MONITOR DISPLAY TO ALLOW THE PILOT TO MAINTAIN SITUATIONAL AWARENESS (E.G. TO DETECT LOSS OF SEPARATION, ASSURE ADEQUATE VERIFICATION AND UNDERSTANDING OF ATC CLEARANCES, AND TO FACILITATE MONITORING THE POSITION OF AIRCRAFT ON PARALLEL APPROACHES). THE PILOT MONITOR ROLE STUDY WILL BE COMPLETED IN FY-1983.

  A SECOND STUDY INVOLVES A COOPERATIVE ROLE FUNCTION WHERE THE PILOT ACCEPTS SOME RESPONSIBILITY FOR PERFORMING A PART OF THE

SEPARATION ASSURANCE FUNCTION AND INCLUDES THE USE OF THE DISPLAY AS AN AID TO THE PILOT IN MAINTAINING SEPARATION FROM SURROUNDING AIRCRAFT (E.G. TO ESTABLISH SPECIFIED SPACING ON THE AIRCRAFT AHEAD AND IN MERGING INTO A STREAM OF TRAFFIC WHILE MAINTAINING THAT SPACING). THE PILOT COOPERATIVE ROLE STUDY WILL BE COMPLETED IN FY-1984.

IN FY-1982, NEW SYSTEMS AND DISPLAY TECHNOLOGY INVESTIGATIONS WILL CONTINUE; AND IN FY-1984, THE CDTI FLIGHT TEST VALIDATION WILL BE COMPLETED.

(VIEWGRAPH #41 OFF   VIEWGRAPH #42 ON)

IN SUMMARY, THERE ARE MAJOR BENEFITS TO THE AVIATION COMMUNITY WHICH WILL BY ACHIEVED FROM THE ENGINEERING AND DEVELOPMENT PROGRAMS SUPPORTING THE NAS PLAN. THESE INCLUDE: INCREASED SAFETY FROM IMPROVED COLLISION AVOIDANCE SYSTEMS AND IMPROVED DISTRIBUTION OF HAZARDOUS WEATHER INFORMATION; REDUCED FUEL CONSUMPTION ASSOCIATED WITH SHORTER DELAYS AT THE MAJOR AIRPORTS; AND IMPLEMENTATION OF AERA NAVIGATION TYPE PROCEDURES WHICH WILL ALLOW POINT-TO-POINT NAVIGATION. A MINIMUM OF ADDITIONAL AVIONICS WILL BE REQUIRED TO OBTAIN THESE ADDITIONAL SERVICES.

IMPLEMENTING THE NAS PLAN WILL BE EXPENSIVE AND WILL TAKE APPROXIMATELY 10 YEARS TO COMPLETE. CRITICALLY IMPORTANT TO THE SUCCESS OF THE PLAN IS THE SUPPORT OF THE AVIATION COMMUNITY AND THE CONGRESS. IT WILL REQUIRE THE CONCENTRATED EFFORT AND SUPPORT OF

ALL ELEMENTS OF THE COMMUNITY TO FIRST STUDY, COMMENT, AND THEN--WE HOPE--ENTHUSIASTICALLY ENDORSE THIS MAJOR FAA INITIATIVE. WE SOLICIT THE COMMITTEE'S SUPPORT IN THIS ENDEAVOR.

THAT CONCLUDES MY PREPARED STATEMENT, MR. CHAIRMAN. AT THIS TIME, MY COLLEAGUES AND I WOULD BE PLEASE TO RESPOND TO YOUR QUESTIONS.

FAA's Engineering and Development Programs

U.S. Department
of Transportation

2/22/82

The Policy Emphasis

- Total System Approach
  - Flexible Enough to Accommodate Future Demands and Technology
  - Accommodate Increasing Rotary Wing Operations

- Improve Vital Safety Services
  - e.g., Collision Avoidance, Weather, Landing Systems

- System Evolution
  - Integrated Air Traffic Control System
  - Commonality of System Components
  - Operational Flexibility
  - Expandability

The Policy Emphasis (Cont'd)

- Maximum Use of Automation
    - Productivity and Capacity
- Consolidation
    - Modern Telecommunications to Capture Economies of Scale
- Modernize 20 + Year Old Plant
    - Mixture of Selective Refurbishment, Replacement, Elimination, and New Technology
- Local Sponsorship of Services and Facilities Best Provided Non-Federally
- Overlay Independent Airborne Collision Avoidance Capability
    - TCAS

The Major System Decisions

General

- ATC Will Continue to Be a Ground-Based System.
- A Major Improvement of the FAA Communications System Will Be Implemented.
- ILS Will Be Supplemented by, and Then Replaced by MLS.
- Work Must Continue on Improvement of Airports and on Achievement of Higher Airport Capacity.
- FAA Will Proceed With Consolidation of Facilities to Achieve Productivity Improvements and Realize System Efficiencies.
- Automatic Weather Observation Systems Will Replace Manual Observers.
- Direct Pilot Access Will Be Implemented.

The Major System Decisions

Automation

- A Common Computer System for Both Terminal and En Route Applications Will Be Procured.
- FAA Will Proceed With Upgrading of ARTS II and ARTS III.
- The Automated Flight Service Station System Will Be Implemented. Major Improvements in Weather Services to Users Will Be Provided.
- The Highest Practical Level of ATC Automation With an Integrated Flow Management Process Will Be Implemented.

The Major System Decisions

Surveillance and Separation

- TCAS Will Be an Independent System.
- Mode S With Data Link Will Replace the ATC Radar Beacon System.
- En Route Primary Radar Will Be Phased Out in 2000. Terminal Primary Radar With a Weather Channel Will Be Continued.
- A New En Route Weather Radar System Will Be Developed to Complement Terminal Radar Weather.

List of Current Development Activities (Supporting the NAS Plan)

A. ATC Automation

B. Flight Service Station Automation

C. Aircraft Separation Assurance

D. Surveillance, Weather, and Communications Systems Modernization

E. Navigation and Landing

F. Airports

G. Advanced Research and Development

ATC Automation

- Near-Term Enhancements
    - Conflict Alert IFR/VFR Mode C Intruder
    - Conflict Resolution Advisories
    - En Route Metering
    - ARTS IIA Enhancements
- Computer Modernization

Conflict Alert IFR/VFR Mode C Intruder

Objective:

Reduce the Threat of Mid-Air Collisions Between Controlled and Uncontrolled Aircraft by Warning the Controller of Potential Conflict Situations Between Controlled Aircraft and VFR Aircraft With Altitude Reporting (Mode C) Transponders.

Status:

— Software Contract Awarded	FY-83
— Software Development Completed	FY-83
— Design Verification Testing Completed	FY-84
— Operational Implementation	FY-85

Conflict Resolution Advisories

Objective:

Provide Automation-Aided Assistance to En Route Radar Controllers in Resolving Potential Conflicts When Violation of Separation Minima Is About to Occur.

Status:

— Contract Award	FY-82
— Software Design Completed	FY-83
— Design Verification Testing Completed	FY-84
— Operational Implementation	FY-85

En Route Metering

Objective:

Provide Automation Aids to the Controller for More Efficient Flight Profile Management, Including Delay Absorption and Optimal-Fuel Descent Profiles.

Status:

— Design Verification Testing Completed	FY-82
— Operational Implementation	FY-83

ARTS IIA Enhancements

Objective:

Enhance the ARTS II System to ARTS IIA by Adding Beacon Tracking, Minimum Safe Altitude Warning (MSAW), Mode C Conflict Alert, and Training Target Generator Capabilities at All ARTS II Locations.

Status:

- Hardware
  - Contract Award for ARTS IIA Hardware and Software FY-82
  - Completed Specification for Hardware Modification Kits FY-82
  - Operational Implementation of Field Modification Kits FY-84
- Software
  - Demonstrated Tracking and Training Target Generator Functions in Upgraded Computer FY-83
  - Demonstrated Conflict Alert and MSAW Functions in Upgraded Computer FY-84
  - Operational Implementation of New Software With New Hardware FY-85

Computer Modernization

Important Factors

- Current System Computer Capacity Is Sufficient Through Mid-1980's With Currently On-Going Improvements
- Available Computer Technology Is Needed to Provide Flexibility to Accommodate the Ranges of Facilities, Capacities and Functions Projected
- Use of Distributed Computers at the Controller Positions Will Provide Needed Flexibility and Reliability
- Technology Is Not a Problem—System Design Is
- Merging of En Route and Terminal Functions Is Needed and Beneficial

Computer Modernization Decision

- Replace Computer Hardware—(Step 1)
  - Keep Present Displays and Software
- New System Design—(Step 2)
  - New System Software
  - New Sector Control Suite
  - Builds on Above Computer Hardware
  - Initial Steps of Automated En Route ATC (AERA)
- Future Automation—(Step 3)
  - Automated En Route ATC (AERA)

Host Computer (Step 1)

Objective:

Hosting of the En Route (NAS) Software in New Computers Will Be the First Step Towards a Common Advanced ATC Automation System for En Route Centers, Consolidated Hubs, and Off Shore Centers.

Status:

— Request for Proposals	FY-82
— Contract Award—2 Contractors	FY-83
— Initiation of FAA Technical Center Demonstration	FY-84
— Operational Implementation	FY-86

System Design (Step 2) (Sector Suites and New Software)

Objective:

An Overall System Design Including Development of New Sector Suites and a New Software System Utilizing Host Hardware Will Result in:

- Consolidation of Existing 23 ARTCC's and 188 Approach Control Facilities Into Approximately 50 ATC Facilities.
- Consolidation of ARTCC and Major Terminal/TRACONS With Common HW/SW System.
- Common Sector Suite Equipment in Both En Route and Terminal Hub Facilities
- ETABS/TIDS Programs Providing Inputs to Sector Suite Design.
- Common Offshore and Continental U.S. Automated En Route Systems.

Status:

— Request for Proposals	FY-82
— Contract Award	FY-83
— Production Award	FY-86
— 1st Sector Suite Operational	FY-87
— New Software Operational	FY-89

Automated En Route ATC (AERA)

Objective:

Automate Routine En Route ATC Functions to Provide Increased Productivity, Increased Safety and Better Accommodation of Pilot's Preferences.

Status:

— AERA Package #1 (Step 2)
(Including Fuel Efficient Clearances and Accommodation of Preferred Routing Requests)

• Completed Data Processing Requirements for Sizing Host	FY-82
• Completion of Requirements Specification	FY-82
• Continue Man-Machine Experiments	FY-83
• Operational Implementation	FY-89

— AERA Package #2 (Step 3)
(Including Automatic Conflict Probe and Automatic Generation of ATC Clearance Messages)

• Completion of Requirements Specification	FY-84
• Operational Implementation	FY-92

Integrated Flow Management (Step 3)

Objectives:

To Provide Better Flow Management on a Systemwide Basis.

Status:

— Completed Operational Requirements Statement for Terminal Arrival Planning Capability	FY-82
— Completed Initial Draft Operational Description of Terminal Planning Aid Components	FY-82
— Finalize IFM Concept Definition Document	FY-82
— Finish T&E of Runway Configuration Management at O'Hare	FY-83
— Completed Requirements and Sizing Analysis for NAS Model	FY-83
— Terminal/Arrival Planning Aid Algorithm Completed	FY-86
— Airspace Configuration Management Algorithm Completed	FY-87

FSS Automation

Objectives:

- Promote Flight Safety Through More Accurate and Timely Pilot Briefings
- Meet Forecast Increased Demand for Services (79% Growth in Hours Flown by 1993)
- Reduce Costs to Provide Services ($1.5 Billion in Savings by 1995)

FSS Automation Status

Model 1	
— Production Contract Awarded (Including Model 2)	FY-81
— Hardware Delivery to FAA Technical Center	FY-82
— Operational Implementation	FY-82
Model 2	
— Delivery to FAA Technical Center	FY-83
— Operational Implementation	FY-84
Model 3	
— Public Demonstration of Voice Response System	On-Going
— Award FSAS Initial Enhancement Contract	FY-83
— Issue Request for Proposals for Additional Enhancements	FY-83
— Operational Implementation	FY-85

Support of the NAS System

Aircraft Separation Assurance

- Conflict Alert and Conflict Resolution
  - Primary System for Assisting Controllers in Reducing System Errors
- Traffic Alert and Collision Avoidance System (TCAS)
  - Backup System for Resolving Near Midair Collision Situations
- An Automatic Traffic Advisory Service May Be Implemented for Limited Terminal Applications

TCAS System Properties

- Independence From the Ground
  - Capable of Compatible Operation With Current and Evolving ATC System
- Based on Internationally Standardized ATC Radar Beacon System—Secondary Surveillance Radar (SSR)
- Range of Capabilities
  - TCAS I—Lowest Cost for Given Level of Protection
  - TCAS II—Maximum Protection for All Environments

TCAS II Requirements

Minimum

- Vertical Maneuvers
- Reliable Operation in High Density Airspace
- Intruder Bearing for PWI
- Crosslink Traffic and Maneuver Advisories to TCAS I; Maneuver Coordination With TCAS II
- Less Than 2 Percent Degradation of Ground Surveillance

Enhancements

- Use of Intruder Bearing Data for Horizontal Miss Distance Assessment (Alarm Reduction)
- Use of Intruder Bearing Data for Horizontal Resolution Maneuvers

TCAS-I Functions and Components

- Provides Surveillance Element for Ground ATC and TCAS-II
  - Transponder
  - Encoding Altimeter
- Displays Maneuver Intent Crosslinked From TCAS-II
  - Transponder Must Be Mode A/C/S
  - TCAS-II Advisory Display
- Listens for Transmissions From Nearby Transponders
  - Passive Transponder Detector

TCAS Program Status

TCAS II

— Draft National Standard for Minimum TCAS II	FY-82
— Minimum Operational Performance Standards and Final National Standard for Minimum TCAS II	FY-82
— Minimum Operational Performance Standards for Enhanced TCAS II	FY-84
— Initial Air Carrier Installations of TCAS	FY-84

TCAS I

— Completed Design Guidelines	FY-82
— Initial Installations of TCAS I	FY-83

Mode S/Data Link

Objectives:

- Basic Upgrade of Air Traffic Control Radar Beacon System (ATCRBS)
- Virtually Eliminate Most Beacon Difficulties (Synchronous Garble, Target Splits, etc.)
- Improve Range and Azimuth Accuracy
- Provide Improved Services to Aviation Community at Lower Cost to Government Using Data Link

Status:

— Mode S	
• Initial Production Procurement	FY-83
• Operational Implementation	FY-86
— Data Link	
• Initiated Development of a Data Link Standard	FY-82
• Completed Data Link Test Plan	FY-82
• Initiated Development of Sector Handoff Service	FY-83
• Completed Development and Test of Data Link Package 1 (Sector Handoff)	FY-87
• Completed Development and Test of Data Link Package 2 (Weather Products, Altitude Assignment Confirmation, MSAW, and Clearance Delivery)	FY-88
• Completed Development and Test of Data Link Package 3 (Weather Map, Additional Weather Products, and Additional ATC Products)	FY-91

Automatic Traffic Advisory Service (ATAS)

Objective:

To Provide Ground-Derived Traffic Advisories in Selected High Density Traffic Areas as Well as Terrain/Obstacle/Restricted Airspace Advisories to Equipped Aircraft Via the Mode S Data Link.

Status:

— ATAS Draft National Aviation Standard	FY-82
— Publish Proposed Final ATAS National Aviation Standard	FY-83
— ATAS Operational Evaluation Report	FY-84

Weather System Modernization

- Weather Radar (NEXRAD)
- Collection and Dissemination of Weather Data (Center Weather Service Unit)
- Automated Weather Observation Systems

Next Generation Doppler Weather Radar (NEXRAD)

Objectives:

Joint DOC, DOD, DOT Program to Develop the Next Generation Doppler Weather Radar.

- Provide Additional Capability Through Doppler Principle, i.e., Radial Wind Velocity, Turbulence.
- Provide Weather Radar for En Route ATC Operations and Many Terminal ATC Operations.

Status:

— Awarded NEXRAD Multiple System Design Contract	FY-82
— Completed NEXRAD Cost Benefit Analysis	FY-82
— Awarded NEXRAD Multiple Validation Phase Contract	FY-83
— Awarded NEXRAD Full-Scale Development Contract	FY-85
— Initial Implementation	FY-87

Center Weather Service Unit (CWSU)/ Center Weather Processor (CWP)

Objectives:

- Improve Accuracy, Timeliness and Availability of Aviation Weather Forecasts, for Time Period "Now" to "6 Hours From Now."
- Provide Integrated Aviation Weather Subsystem to National Airspace System (NAS) Which Will Upgrade Weather Support to ATC Facilities

Status:

– Phase I—Automation of CWSU Work Station and Capability to Disseminate Weather Data to ATC Specialists and Pilots	
• Completed Engineering Requirement for Center Weather Processor (CWP)	FY-82
• Issued Request for Proposals for CWP	FY-83
• Operational Implementation of CWP	FY-85
– Phase II—Provide Weather Contours on Controllers' Displays	
• Completed Feasibility Demonstration Using Field Controllers	FY-82
• Completed Software Development	FY-83
• Operational Implementation	FY-85
– Phase III—Interface NEXRAD With CWP	
• Completed Specification for Processing Doppler Weather Radar Data	FY-86
• Operational Implementation (Concurrent With NEXRAD)	FY-87

National Airspace Data Interchange Network (NADIN)

Objective:

Enhance NADIN System to Handle the Data Transfer Requirements of FAA's New Systems Such as Mode S Data Link, Advanced Weather System (AWES) and Remote Maintenance Monitoring System (RMMS).

Status:

— Completed Design of Remote Maintenance Monitoring Enhancement	FY-82
— Initial Operational Implementation of NADIN	FY-83
— Completed Design of Enhancements to Transfer Data Between Centers	FY-83
— Additional Enhancements Completed (Weather, Central Flow Control, Mode S, Facility Consolidation and Advanced Computer System)	FY-85

Voice Switching and Control System (VSCS)

Objectives:

Provide a Voice Switching and Control System to:

- Support Flexible Operations in New and Consolidated Air Route Traffic Control Centers
- Reduce Leased Line and Equipment Costs
- Enhance Controller Productivity
- Permit the Eventual Transmission of Voice and Data Over an Aeronautical Satellite-Based System
- Suitable for Both the Enroute and Terminal Operations of the FAA System

Status:

— Developed VSCS Specification	FY-82
— Issued Request for Proposals	FY-83
— Awarded Prototype Contract	FY-84
— Evaluation of Prototypes Completed	FY-86
— Operational Implementation	FY-87

FAA Navigation

Near Term

- LORAN-C Off Shore, Remote Area Navigation Certification

Future System

- Analysis of Alternative System Configurations
  - Cost Analysis Studies
  - Technical Evaluations, LORAN-C, GPS, Area Navigation
  - GPS Emphasis
  - FAA Assessment

NAVSTAR/GPS

Objective:

- Define the Future Role of NAVSTAR/GPS as an Element of the Civil Aviation Navigation System

Implementation Considerations:

- Institutional
    - System Control (Denial of Access/Accuracy)
    - International Standardization for Civil Use
- Cost
    - Cost Recovery Policy
    - User Equipment Cost
- Technical
    - Accuracy
    - Coverage
    - Reliability/Integrity

NAVSTAR/GPS Status

— Completed Testing Military "Z" Set	FY-82
— Completed Testing of Experimental General Aviation Receiver	FY-83
— Recommendations to DOT on Federal Radionavigation Plan	FY-83
— Completed Development of Minimal Performance Standards for General Aviation GPS Avionics	FY-84
— Completed Development of GPS Operational Procedures	FY-85

Microwave Landing System

Objective:

- Develop and Implement New Terminal Guidance System With Improved Accuracy and Operational Flexibility

Status

- Preparation of Draft Precision Distance Measuring Equipment (PDME) Standards and Recommended Practices (SARPS) FY-82
- PDME SARPS AWOP* Approval 3
- PDME SARPS Approval by ICAO 4
- Start MLS Operational Implementation Y-85

*All Weather Operations Panel

MLS Service Test and Evaluation Program (STEP)

Objective:

- Demonstrate MLS Capabilities in an Operational Environment in Conjunction With the Development of Operating Procedures

Status:

— Washington National (RNWY 18) (Bendix Basic Narrow)	3/79-9/83
— Philadelphia International (RNWY 17) (TI Small Community)	4/80-9/83
— Washington National (RNWY 33) (Bendix Small Comm.)	12/80-9/83
— Clarksburg, W.V. (RNWY 21) (Hazeltine Small Comm.)	8/81-9/83
— Operational Evaluation Report Completed	FY-84

Airports Program

Objectives:

- Improve Runway Traction and Methods for Removal of Rubber Build Up on Runway Pavements
- Evaluate New Marking, Lighting and Visual Approach Aids
- Improve Airport Pavement Design, Materials and Construction Criteria and Development Life Cycle Management

Status:

— Traction	
• Final Report on Effects of Runway Drainage on Surface Traction	FY-82
• Completed Initial Report on the Problem of Rubber Build Up on Porous Friction Concrete	FY-82
• Final Report on Effects of Runway Surface Treatments on Tire Traction	FY-83
— Lighting	
• Final Report on Evaluation of Precision Approach Path Indicator (PAPI)	FY-83
• Final Report on Marking and Lighting of Unpaved Runways	FY-84
— Pavement	
• Completed Mathematical Model to Determine Frost Effects (Heave and Thaw) in Pavements	FY-83
• Developed Criteria for Pavement Design Using Non-Woven Fabrics to Prevent Reflective Cracking	FY-84
• Completed Improved Overlay Thickness Criteria That Will Reflect Current Aircraft Loading	FY-84

Advanced Research and Development

Objective:

Investigation of Advanced Control Concepts and Application of Advanced Technology to Improve the ATC System.

Status:

— Practical Wake Vortex Detection and Avoidance Methods

• FM-CW Radar Evaluation	FY-82
• Sensor Technology Explorations	Continuous
• Advanced Vortex System Detection and Avoidance Concept Design	FY-86*
• Engineering Specification for Advanced Vortex System	FY-90*

*Date Contingent on Successful Sensor Development.

Advanced Research and Development (Cont'd)

— New Ways to Achieve Airport Capacity Including Management of Runway Occupancy Time	
• Completed Simulation Test Plans for Closely Spaced Independent Parallel Approaches	FY-82
• Technology Investigations to Identify Other Means to Improve Airport Capacity	Continuous
• Runway Occupancy Time Study Review and Assessment	FY-84
— Optimal Human Roles in Highly Automated Systems	
• Determination of Man-Machine Requirements Derived From Experiments Conducted in the Advanced Computer, Sector Suite, AERA and Other Advanced Automation Programs	Continuous
— Fault-Tolerant Computer Systems	
• Developed Fault-Tolerance Evaluation Criteria for Application to the Computer Replacement Program	FY-83
• Determine the Level of Fault-Tolerance Necessary to Maintain Operational Integrity of Various Air and Ground Subsystems	FY-86

Mr. Glickman. Thank you, Mr. Albrecht.

I would like to ask Mr. Hunt to come up with you, if you do not mind, because I want to ask you a general question.

I guess one of the biggest questions I have is, before we get into the specifics of this program, the enormity of the effort that you are contemplating requires what I consider to be very skilled and competent management capability.

You, I believe, have hired Mr. Hunt, who has some experience in the computer operations, but unless it is managed competently, this could make some of the gold plating or cost overruns associated with certain aspects of the DOD defense spending look like small potatoes.

So, therefore, I would like to get some description by you of how you intend to manage this program.

Mr. Albrecht. We have at least three things going for us, Mr. Chairman, that will help in this direction. First is Mr. Hunt, of course, and his background, and we can describe that for you if you wish. Second is the administrator. Mr. Helms came along at just the right time. He is certainly skilled in systems engineering. He understands acquisition programs. He understands how to motivate people. I think we are very fortunate to have him on board at this time.

Third, within the FAA, we have a body of air traffic control system specialists that I submit are second to none. We know that field very well, so in no way will we abdicate systems responsibility for the development of this replacement system.

In terms of managing the program, a number of changes have been made. Mr. Helms has overhauled the major systems acquisition management process. He has established a review board which he will chair, consisting of associate administrators, which will basically review and approve all major program decisions. He will personally review changes in program schedules and budgets.

We have established an organizational complex consisting of a program office with functions unique to that program that can interface with contractor work forces and the balance of the technical organization.

We have looked at the problems which we have had in the past of interfacing between the engineering development and the airway facilities complexes, and basically, the program office will assure continuity. That program office will survive during the course of the program. Technical people from the airways facilities group and the airways traffic group will be part of that program office for transition planning starting immediately.

I think we have spent the better part of a year getting our act together, to put our arms around this problem. We agree with you in terms of its complexity. But I think we have addressed the major problems.

Mr. Hunt might have some words he would like to add.

Mr. Glickman. Why don't you just give the committee, in a general shorthand way, how you envision you are going to set up an organizational chart and how you are going to manage how you relate to industry, what your position will be within the structure of FAA. Mr. Hunt?

Mr. Hunt. As the Director of the Advanced Automation Program Office, I will be responsible for setting up an organization whose primary function is to manage these projects. I foresee having a systems engineering group dedicated to this function. I see a design engineering group who would manage the technical aspects of the contractors' work, who would provide day-to-day monitoring of their activities, reports on their performance. We would have scheduled reports on a weekly basis.

Mr. Glickman. How many people would be directly accountable to you in terms of the management of this program?

Mr. Hunt. In the vicinity of 50.

Mr. Glickman. And would these people otherwise be people who are working within the FAA on other things, or are these new people?

Mr. Hunt. These would be people who would be dedicated to this project but who currently are employed by the FAA, for the most part.

Mr. Glickman. Al, did you have something to add to that?

Mr. Albrecht. No, I agree with that statement. There are experienced people within FAA that have been transferred to the program office on a full-time basis.

Mr. Glickman. Will this in any way take away or diminish functions that they otherwise were doing? These are fairly talented people, I assume. What I am saying is, are you going to suffer as a result of having to take those people from somewhere else?

Mr. Albrecht. Sure, Mr. Chairman. You can never have quite enough good people. But the flight service station program is coming down, the MLS program is coming down, so we are in a position of having people becoming available that do have the background and experience.

Mr. Glickman. What is your line authority in terms of operation within the FAA?

Mr. Hunt. At the current time, I report to Mr. Albrecht. In future time, it is likely that I will report at a higher level.

Mr. Albrecht. The Administrator has made it clear he is going to take a direct hand in this program.

Mr. Glickman. So you would be reporting to Mr. Albrecht but also probably to Mr. Helms directly, then?

Mr. Albrecht. I am going to help him, but he also has to answer to Mr. Helms.

Mr. Glickman. Yes, OK. And you feel comfortable with this management role and the niche that they have carved out for you in terms of giving proper management to this plan?

Mr. Hunt. Yes. I view it as a great challenge, but I think it is a workable arrangement.

Mr. Glickman. Now, you were with which company before?

Mr. Hunt. I was with Computer Sciences Corp. for a number of years. I have previously served with the Government at the CIA for 4 years. My position there was one in which I was responsible for acquiring major computer systems for the agency.

Mr. Dunn. The chairman asked the question yesterday about different people, and he asked the same question about groups that will be involved and the current air traffic controllers, but we have not mentioned DOD. Now, they use the same airspace but different computers.

In the new computer program, will DOD and their airspace requirements make use of the same computers? Are they being brought in on it now, or do we still envision pretty much of a separation system?

Mr. ALBRECHT. Well, we control both DOD and civil traffic in the civil airspace. DOD has their own special instrumentation requirements. That basic philosophy we do not expect to change.

Mr. DUNN. But are they involved in the computer redesigning, then?

Mr. ALBRECHT. In the sense that we have fairly tight coordination between NASA and ourselves and between DOD and ourselves. We are not asking them to participate in the design of the air traffic control computer system. We are coordinating with them on what requirements DOD may have and to assure they are cognizant of how the system will be evolving.

Mr. GLICKMAN. You have not given us any breakdown or any amounts of money that you are requesting for the R. E. & D. programs. Mr. Helms yesterday really only talked about some aggregate numbers, $8 billion or $7 billion.

Mr. ALBRECHT. Right.

Mr. GLICKMAN. Do you have those numbers today, the breakdown, and if not, when can you get us a detailed breakdown on the numbers for the R. E. & D. program?

Mr. ALBRECHT. Mr. Chairman, they are in the same status as the overall program that Mr. Helms described to you yesterday. I think he committed to have those numbers in your hands very shortly. At the same time, you will have the R. E. & D. breakdown.

Mr. GLICKMAN. OK, because Mr. Dunn and I have signed a letter to Mr. Helms, which we mentioned to him yesterday, which asks for that breakdown. I may just give that to you to give to him today.

Mr. ALBRECHT. Fine. We will be glad to respond.

Mr. DUNN. It saves postage. [Laughter.]

Mr. GLICKMAN. Well, the postage is paid, but the question of whether they will receive it or not is another one, so this way I know he will get it if I give it to you.

Mr. ALBRECHT. We will guarantee delivery.

Mr. GLICKMAN. I understand that you will propose that funding of the regulatory support R. & D. contained in the F. E. & D. account will come from the trust fund. Congress, as you know, rejected that idea last year in the appropriations bill. I am wondering why you still feel this is a good idea, if in fact you do.

Mr. ALBRECHT. Well, Mr. Chairman, it is basically an administration decision. We can work either way. It really does not make any difference.

Mr. GLICKMAN. OK. Again, that is not made essentially by FAA, then; that is an OMB decision?

Mr. ALBRECHT. Well, it comes from my administrator. I am not sure where he got it.

Mr. GLICKMAN. OK. I just would let you know, so you could relate to him, that we still have some concern about the whole issue of trust fund use for a variety of nonhardware related items.

Mr. ALBRECHT. I understand.

Mr. DUNN. While the chairman is on the trust fund question, it is my understanding that general aviation's portion would go up 2 cents a year under the proposed——

Mr. ALBRECHT. I believe that is the proposal that the Administrator mentioned yesterday.

Mr. DUNN. That is a builtin inflation rate of something like about 15 percent a year, correct? Yes, is that correct?

Mr. ALBRECHT. It depends how you call it, Mr. Dunn. The 2 percent based on the current——

Mr. DUNN. If it were based on the current, then it would be considerably higher than 15 percent a year.

Mr. ALBRECHT. Well, I am the wrong guy to get involved in a financial discussion of the taxing business.

Mr. DUNN. That just seems arbitrarily high, since we seem to have won the battle on inflation. Inflation is down around 5 percent now. I just wonder if we need that kind of increase.

Mr. ALBRECHT. I think the Administrator has expressed a feeling that there is no free lunch, and in many ways users should bear a part of the expense of the system.

Mr. DUNN. I don't think they are objecting to bearing a part, but I know they are objecting to the built-in figure of 2-percent increase per year, and I would tend to agree with them that to arbitrarily say we are going to add 2 cents to it every year seems——

Mr. ALBRECHT. Well, I am sure that a good deal of thought went into determining that proposal. I am not in a good position to explain the detailed basis for it.

Mr. GLICKMAN. I think the Administrator is aware of congressional opposition that probably will develop to that incremental increase.

Mr. ALBRECHT. Right.

Mr. GLICKMAN. I would like to ask—the justification for your approach to computer modernization rests largely on estimates of when saturation will occur, when demand will occur. I am always reminded that the Edison Electric Institute had these incredible estimates of electricity usage in America, and just strangely, in the last 3 years, they have not been met because of a variety of things that have happened regarding energy conservation, economy, and that kind of thing.

So what I really want to know is: Have you done any sensitivity analyses to see what happens if your demand forecasts are way off?

Mr. ALBRECHT. We have looked at that problem in several ways, Mr. Chairman. First of all, we are almost a little late already if our demand forecasts are correct, in that we really do not have any extra time to implement this system.

Traditionally and typically, our forecasts have erred on the low side, in that we have underestimated traffic growth.

Mr. GLICKMAN. You have not included Sir Freddy Laker going bankrupt in your demand estimates?

Mr. ALBRECHT. No; we don't worry about it. His traffic is not a major factor in our analysis.

In addition, of course, there are many other reasons besides just the traffic growth forecasts that cause us to propose this program. There is the age of the equipment, as was discussed yesterday.

There certainly is a need to add more automation functions so we can avoid stacking more controllers on top of each other.

The basis for the whole plan is really a need for a new system. The Administrator talked about replacing vacuum tube systems with solid state systems. That is part of the plan. If you look at that whole package, it is not just a computer replacement; it is really a total system upgrade.

Mr. GLICKMAN. What you are saying, then, is that while you believe that your saturation figures are correct, that the system modernization needs to be done irrespective of that.

Mr. ALBRECHT. It is needed. Yes, sir.

Mr. GLICKMAN. OK.

The second question, I guess, relates a little bit to that. I am concerned a little bit about the risks. What risks are associated with the enterprise that you are talking about, risks involving, for example, how much of the present software must be rewritten to make it run on the host computer?

I do not know much about computer technology, but I do know that conceivably there is an element of uncertainty in this whole thing, and I thought you might want to comment on that.

Mr. ALBRECHT. Fine. Your concern is very valid, Mr. Chairman. That was one of the major factors that Mr. Helms included in the system review we have been going through since last February.

In assessing alternatives, we were concerned about the costs; we were concerned about the technical risks involved. That is one of the reasons that the approach changed somewhat from the one we had before his arrival. We are now talking about a host that can take existing software. We are not dependent upon rewriting all of that software before the system will work. We are talking about taking a host that has current, today's technology, which is 23 years better than what we are now using, but we are not depending on something happening in the future.

So one major element of this system's evaluation has been, how can we eliminate technical risks, because we cannot afford any.

Mr. GLICKMAN. And, to the extent that you can quantify it, how far do you think you have gone to eliminate that technical risk?

Mr. ALBRECHT. Well, you asked to what extent are we going to redo the software, for example. I think Neal will tell you it is, at the most, 5 to 10 percent. It is a small effort compared to the half million lines of code that are in that software.

We do not assess technical risks per se as a problem; we do assess transition of what we now have into a new system, and the way we do that with the controller work force is something we need to be very careful about.

Mr. GLICKMAN. Do you have a plan on paper yet as to how you are going to make that transition?

Mr. ALBRECHT. We are developing that. I mentioned that we have AT and AF people in the program office structure. They are there to work the transition problem at a very early date.

Mr. GLICKMAN. Is that under Mr. Hunt's situation?

Mr. ALBRECHT. Yes.

Mr. HUNT. Yes; that is a plan that we are developing at this time. We expect, within another 6 weeks to 2 months, to have such a plan initially finalized.

Mr. **Glickman**. I would hope that when you get that, you could share that with the subcommittee. I think we would like to see—I think the community, the public at large would like to be secure that you can make this transition and still operate the system safely.

Mr. **Albrecht**. We plan to make it very visible.

Mr. **Hunt**. We will be happy to share that with the committee.

Mr. **Glickman**. Mr. Dunn, do you have any questions?

Mr. **Dunn**. Thank you, Mr. Chairman.

I would like to go back to the TCAS, your chart V-12. Under TCAS requirements, vertical maneuvers, reliable operation, high density, intruder bearing, and, No. 3, crosslink traffic and maneuver advisories to TCAS I and maneuver coordination with TCAS II.

Now, your chart is called Requirements. I see nothing in this chart that says TCAS must also be coordinated with ground controls.

On your chart V–14, you are talking about drafting national standards this year, for 1982. My question, once again, is when TCAS sends a notice to that pilot that he has got to take a deviation move, is the controller on the ground, in the same instant, going to be aware that one of his aircraft is about to deviate from the plan that he has got him on? Yes or no?

Mr. **Blake**. The TCAS national standard, which I have read, contains that capability; yes.

Mr. **Dunn**. Could I please have a copy of that sent to my office?

Mr. **Blake**. It will be out, I think, within the month, the final version.

Mr. **Glickman**. How is that done?

Mr. **Blake**. Pardon?

Mr. **Albrecht**. The question was, how is it done, Neal?

Mr. **Glickman**. Yes. How do they do that? How does he know?

Mr. **Blake**. Well, the signal format is provided so that one can read out whatever is displayed to the pilot at the time it is posted in front of the pilot. It is then available for use on the ground.

Mr. **Albrecht**. I think that translates in that the capability will be provided, so that signal can go to the ground. How it is used on the ground, how it is displayed, is something I do not think we have worked out yet.

Mr. **Dunn**. You are not sure how it is going to be displayed, but you are sure that is part of the requirements that the ground has to know at the same time?

Mr. **Albrecht**. That is right.

Mr. **Dunn**. OK. You know, you and I spent a lot of time discussing this, and I just feel it is of ultimate critical nature that the guy controlling seven or eight aircraft know that one of his aircraft is about to deviate from the plan.

Mr. **Glickman**. You would have to have a data link, though.

Mr. **Albrecht**. We plan to have a data link, Mr. Chairman. That is a basic building block in the system, the mode S data link.

Mr. Dunn, we appreciate your concern. It is also partially an air traffic problem in terms of their procedures and their controllers, so that is why I am not glib in terms of telling you exactly how we are going to do it. But we understand that requirement.

Mr. DUNN. I am not asking for details on exactly how you are doing it. I am concerned that it is one of the basic requirements being written into these national standards that we are developing for this year.

Do you know how much money—later on, you also talked about pilot display of air traffic. We also discussed that same issue in LA. Do you know how much money is being spent on cockpit display of other traffic advisers?

Mr. ALBRECHT. Well, there are several answers to that question. By the FAA, very little, and we can get an answer here in a minute. By the FAA and NASA, some more, because NASA has a TCV program that involves traffic displays. By the airlines, quite a bit. If you look at the 757, 767, and look at future aircraft coming up, in the 310A case, there are five cathode ray tubes. The 757 has, I believe, three. So there is a very distinct trend to go toward cockpit cathode ray tube displays, but those are for flying the airplane. It turns out they are a lot more reliable than some of the other normal instruments.

In terms of cockpit display of traffic information, we and NASA are trying to sort out how this can best be used.

Mr. DUNN. It is my same concern, a distinction between who is separating aircraft, whether it is ground control or whether it is 20 pilots on the channel, and I have a big concern as to which way we are going to go, and I see it as a major policy shift if we are ever to leave the decision to——

Mr. ALBRECHT. No, Mr. Dunn, there is no policy shift in terms of our saying the ground system is the primary separation service to be provided. The question is, Can you assist that procedure by providing some information in the cockpit that is not there? But we have no change in philosophy.

We will supply for the record numbers in terms of money being spent, if that is satisfactory.

Mr. DUNN. I thank you.

Mr. GLICKMAN. I would just add another point that I mentioned to Mr. Helms yesterday. In your design of the software and as you deal with issues such as the suites that you are going to be designing, I sure hope that you do in fact listen to the voices of your operating controllers as to what they exactly need as they separate aircraft, because if you do not, then you are going to have problems later on.

Mr. ALBRECHT. Well, Mr. Chairman, Mr. Helms has a saying that says, "Work together, or work someplace else," and that includes air traffic controllers. So there is no question that we are going to do that.

Mr. GLICKMAN. I seem to have heard him say that before.

Mr. ALBRECHT. Yes.

Mr. GLICKMAN. I think that you have answered our questions. There is a lot of technical data here which I think the staff will review in more depth, but I am hopeful that you can give us the specific numbers, both for the specific accounts I talked about as well as for some of the more aggregate figures.

We will give you this letter now, and we will be back in touch with you if we have any additional questions.

Mr. ALBRECHT. All right, fine. Thank you.

Mr. GLICKMAN. Thank you.

The hearing is adjourned.

[Whereupon, at 2:55 p.m., the subcommittee adjourned.]

APPENDIX

Statement
Bob Shamansky
FAA R&D 1983 Budget Authorization
2/23/82

MR. CHAIRMAN, ADMINISTRATOR HELMS, I SUPPORT THE ACTION OF THE CHAIRMAN AND THIS COMMITTEE TO EXPEDITE THE PROGRAM REPORT BY THE FEDERAL AVIATION ADMINISTRATION REGARDING THE NATIONAL AIRSPACE SYSTEM PLAN. I AGREE THAT THIS COMMITTEE NEEDS TO CONSIDER NOW THE FUNDING NECESSARY TO BEGIN IMPLEMENTATION OF THE PLAN.

I ALSO WANT TO MAKE SURE THIS NEW AIR TRAFFIC CONTROL COMPUTER SYSTEM IS FUNDED ADEQUATELY. THERE SHOULD BE NO CONFUSION ABOUT OUR GOALS. WE CANNOT AFFORD ADDITIONAL DELAYS IN UPGRADING THE NATION'S COMPUTER AIR TRAFFIC CONTROL EQUIPMENT, ESPECIALLY ANY DELAYS CAUSED BY LACK OF FORESIGHT ON OUR PART.

FROM OUR HEARINGS WE LEARNED THAT THE CURRENT SYSTEM LACKS COMPUTING SPEED AND STORAGE CAPACITY TO ACCOMMODATE PROJECTED FUTURE AIR TRAFFIC. PRESENT CAPACITY ALSO IS INSUFFICIENT TO ACCOMMODATE FUTURE FLIGHT SAFETY AND MANAGEMENT PRODUCTIVITY IMPROVEMENTS. SPARE PARTS FOR THE CURRENT EQUIPMENT ARE INCREASINGLY EXPENSIVE AND THIS ALSO INDICATES THAT A NEW SYSTEM IS NEEDED.

AIR TRAFFIC IN THE UNITED STATES HAS BECOME MORE AND MORE CONGESTED OVER THE LAST DECADE. INCREASED TRAFFIC HAS CUT THE MARGIN OF SAFETY IN AIR TRAVEL. THEREFORE, MODERNIZATION OF THE NATIONAL AIR TRAFFIC COMPUTER SYSTEM IS PARAMOUNT.

(MORE)

Advanced Research and Development (Cont'd)

— Computer-Aided Reasoning in ATC and Cockpit Operations	
• Evaluate Computer-Aided Decisionmaking Process	Continuing
— Advanced Applications of Satellites for ATC Surveillance (Mode S Avionics)	
• Determine the Feasibility of Using Mode S System in Conjunction With Satellites as a Basis for the Future ATC Surveillance System	FY-85
• Determine the Technical and Operational Characteristics of a Space-Based Surveillance System	FY-88
— Optimal Cockpit System Integration in the Evolving ATC System	
• Completed Pilot Monitor Role Study	FY-83
• Completed Pilot Cooperative Role Study	FY-84
• New Systems and Display Technology Investigations	Continuous
• CDTI Flight Test Validation	FY-84

User Benefits

- Increased Safety Through Collision Avoidance and Improved Weather Information
- Reduced Delays
- Reduced Fuel Consumption
- Proliferation of Point-to-Point Navigation
- No Additional Equipage Required for Most New Services

Mr. Chairman, I applaud your leadership on this vital matter and look forward to reviewing the Federal Aviation Administration's report.

Thank you.

--Bob Shamansky

sr/er

FIVE YEAR RE&D PLAN-CURRENT YEAR DOLLARS MARCH 16,1982
FY 1983-1987

PROGRAM	TITLE	FY-82	FY-83	FY-84	FY-85	FY-86/87	TOTAL FY83-87
01	SYSTEM	8282	11877	18572	26165		126980
02	RADAR	0	0	0	0		0
03	BEACON	4286	4274	5863	6380		26772
05	ASA	9162	8375	5181	2169		15725
06	COMMUNICATIONS	4706	10464	15451	15566		64921
08	AIRPORT/AIRSIDE	3412	3081	6218	5805		27504
09	AIRPORT/LANDSIDE	0	0	0	0		0
10	OCEANIC	0	0	0	0		0
11	ATCSCC	0	0	0	0		0
12	ENROUTE	5915	4033	5118	1659		11475
13	FSS	2451	3414	4876	5104		24226
14	TERM	6142	2946	3171	2169		11118
16	TECH	1694	3533	3462	4236		26674
17	SATELLITE	0	0	0	0		0
21	SUPPORT	2166	3099	9569	10016		42981
TOTAL		48216	55096	77481	79269		378376
23	ADVANCED COMPUTERS	11240	47000	156641	134542		470446
TOTAL		11240	47000	156641	134542		470446
04	NAVIGATION	4439	2515	4681	5155		19968
07	APPR & LANDING	3833	2761	5791	6157		24269
TOTAL		8272	5276	10472	11312		44237
15	WEATHER	4901	8068	15427	19905		89175
TOTAL		4901	8068	15427	19905		89175
19	AVIATION MEDICINE	3173	3060	5161	4221		19490
TOTAL		3173	3060	5161	4221		19490
18	AIRCRAFT SAFETY	5500	13000	18364	17201		82540
TOTAL		5500	13000	18364	17201		82540
20	ENVIRONMENT	2000	2000	2438	2552		12408
TOTAL		2000	2000	2438	2552		12408
GRAND TOTAL		83302	133500	285984	269002	408186	1096672

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  REPORT DATE 03/16/82              R&D 5 YEAR PLAN (      TO FY-87)                                        1

  KEY S CLASS     PROJECT  PP TITLE                      FY-82   FY-83   FY-84   FY-85            TOT 83-87

  013 1 ENROUTE   2A-06    01 AERA                        2240    4094    9752   15312                76444
  118 1 ENROUTE   2A-07    01 IFR-NATIONAL FLOW             98     300     731     764                 7508
  093 0 ENROUTE   2A-10    01 OVER OCEAN IMPROVEMENTS      524     116     488     636                 2597
  059 0 ENROUTE   2A-11    01 VERTICAL SEPARATION STANDAR  975    1550    1215    1276                 5126
  070 0 ENROUTE   2A-12    01 HORIZONTAL SEPARATION STAND  690     700     914    1021                 4861
  012 1 TERMINAL  2B-06    01 IFR - TERMINAL FLOW          470     456    1215    1786                 6440
  140 1 TERMINAL  2B-07    01 AIRPORT CAPACITY (1 OF 2)    262     112     890    1046                 4269
  135 1 TERMINAL  2B-08    01 AUTOMATED AIRCRAFT SERVICES   16     216     488    1276                 6043
  351 0 GROUND A  2D-05.1  01 FUTURE NAV SYS (1 OF 2)      152     115       0       0                  115
  169 C AIRBORNE  5 -07    01 CDTI                         280    1182    1402    1595                 5840
  356 0 ASSO DEV  7 -      01 FUTURE ATC SYSTEM CONCEPTS     0       0       0       0                    0
  216 0 ASSO DEV  7 -02    01 BENEFIT-COST ANALYSIS         85     348     341     268                 1522
  219 C ASSO DEV  7 -03    01 SYS ANAL & INTEG (1 OF 2)   2161    1623     368     383                 3185
  224 C ASSO DEV  7 -06    01 ATCS SAFETY ANALYSIS         300      31     457     479                 1982
  148 0 ASSO DEV  7 -12    01 ALTERNATIVE SEPARATION CONC   29      30     305     319                 1108

  TOTAL PROGRAM                                           8282   11877   18572   26165               126980

  243 C GROUND A  2D-02.1  03 MODE-S EXPER TEST BED SUPPO 2467    2770     366       0                 3136
  233 1 GROUND A  2D-02.3  03 MODE S ENHANCE                 0       0    3303    4338                14253
  011 1 GROUND A  2D-02.4  03 MODE S ATAS                 1819    1504    2194    2042                 9383

  TOTAL PROGRAM                                           4286    4274    5863    6380                26772

  352 1 GROUND A  2D-04.1  04 PRECISION DME                773     139       0       0                  139
  229 0 GROUND A  2D-05.1  04 FUTURE NAV SYS (2 OF 2)     2660    1721    1670    1710                 7548
  147 0 GROUND A  2D-05.2  04 NAV CERTIFICATION SUPPORT      0       0    1329    1646                 5072
  027 1 ROTOCRAF  9 -02    04 LOW ALTITUDE ATC             476     300     853     957                 4323
  322 0 ROTOCRAF  9 -03    04 EXTENDED NAV COVERAGE        530     355     829     842                 2890

  TOTAL PROGRAM                                           4439    2515    4681    5155                19968

  050 0 AIRBORNE  5 -08    05 TCAS                        8762    7075    4754    2169                13998
  323 0 ROTOCRAF  9 -05    05 ROTOCRAFT TCAS               400    1300     427       0                 1727

  TOTAL PROGRAM                                           9162    8375    5181    2169                15725

  042 1 ENROUTE   2A-09    06 VSCS                         254    5932    9143    8549                28764
  136 1 GROUND A  2D-02.2  06 MODE S DATA LINK            3575    2699    3474    4338                14990
  043 1 INTERFAC  2E-01    06 RADIO ENHANCEMENTS           100     732    1219    1786                 7006
  122 1 INTERFAC  2E-02    06 HUB CONSOLIDATION MULTIPLEX  100     100       0       0                  100
  124 1 INTERFAC  2E-03    06 PACKET RADIO                 100       0       0       0                    0
  123 1 INTERFAC  2E-04    06 RML SYSTEM REPLACEMENT       250     525     365       0                  830
  134 1 INTERFAC  2E-05    06 SATELLITE TRUNKING             0       0       0       0                 4060
  319 1 INTERFAC  2E-06    06 COMM SYSTEM DESIGN           250     175     731       0                  906
  298 0 INTERFAC  2E-07    06 LOCAL AREA NETWORK FOR CENT   77     301     457     893                 3143
  036 0 ROTOCRAF  9 -04    06 ROTO COMM                      0       0     122       0                  122
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                                   11
   REPORT DATE 03/16/82                EED 5 YEAR PLAN (FY-8   FY-87)                                      PAGE
 KEY S CLASS    PROJECT PR TITLE                          FY-82   FY-83   FY-84   FY-85             TOT 83-87

   TOTAL PROGRAM                                           4706   10468   15451   15566                 64921

 048 1 FSS        2C-06    07 WEATHER DISPLAY FOR GA COCK    105       0       0       0                     0
 030 1 GROUND A   2D-04    07 ESTABLISH MLS (STEP)          2700    1649    2072    1021                  6071
 321 0 GROUND A   2D-04.2  07 SEGMENTED & CURVED APPROACH      0       0    1215    1659                  3676
 330 0 GROUND A   2D-05.3  07 PILOT FACTORS NAVIGATION        80     277     366     255                   898
 172 0 AIRBORNE   5 -01    07 FLIGHT PHASE STATUS MONITOR    309     677     731     766                  3258
 171 0 AIRBORNE   5 -02    07 COCKPIT DATA MGT REQUIREME      46      89     610     841                  3182
 158 0 AIRBORNE   5 -03    07 HUD                            608      19       0       0                    19
 163 0 AIRBORNE   5 -04    07 HDD                              0       0       0     510                  1048
 162 0 AIRBORNE   5 -05    07 VOICE INPUT & OUTPUT SYSTEM      0       0     183     447                  1020
 260 0 AIRBORNE   5 -12    07 WORKLOAD MEASUREMENT            25      50     610     638                  4888

   TOTAL PROGRAM                                           3833    2761    5791    6157                 24269

 253 1 TERMINAL   2P-07    08 AIRPORT CAPACITY (2 OF 2)      696     100     610     510                  1626
 021 1 FSS        2C-07    08 WAKE VORTEX SYSTEMS            107       0     975    1021                  5190
 049 0 AIRPORTS   3 -01    08 LIGHTING AND VISUAL AIDS       311     584     610     510                  2788
 126 0 AIRPORTS   3 -02    08 RUNWAY SURFACE CHARACTERIST    357     500     853     447                  2955
 127 0 AIRPORTS   3 -03    08 CRASH FIRE RESCUE              316      67     183     191                   712
 100 0 AIRPORTS   3 -04    08 PAVEMENT MATERIALS & CONSTR    200     300     853    1021                  4202
 101 0 AIRPORTS   3 -05    08 PAVEMENT DESIGN EVAL & MGT    1044    1094     731    1021                  5283
 125 0 AIRPORTS   3 -06    08 AIRPORT MAINT- GND OPS         150     366     305     319                  1657
 196 0 AIRPORTS   3 -07    08 AIRPORT TERMINAL IMPROVEMEN    350      70     610     510                  1598
 129 0 AIRPORTS   3 -08    08 AIRPORT CONFIGURATION IMPRO     81       0     488     255                  1785
 150 0 FCTOCRAF   9 -11    08 * HELIPORT PLANNING & DESIG      0       0     366     638                  1004
 650 0 (DEDUCT)   (NONE)   08 * #150 FUNDS IN 099 & #129       0       0    366-    638-                 1004-

   TOTAL PROGRAM                                           3812    3081    6218    5805                 27508

 002 1 ENROUTE    2A-01    12 CONFLICT ALERT MODE C INTRU    800     660     762       0                  1422
 003 1 ENROUTE    2A-02    12 CONFLICT RESOLUTION ADVISOR    950     830     305     638                  1773
 001 1 ENROUTE    2A-03    12 ENROUTE METERING - 2           800     670     610       0                  1280
 308 0 ENROUTE    2A-05.1  12 PERFORM FOR ADVANCED SYSTEM    275     183    1768    1021                  3597
 205 1 ENROUTE    2A-05.2  12 DISPLAY TECH FOR SECTOR SUI   3484    1580    1020       0                  2600
 016 1 ENROUTE    2A-08    12 ARTCC CONSOLIDATION             10     150     649       0                   799

   TOTAL PROGRAM                                           5815    4033    5118    1659                 11475

 120 1 FSS        2C-01    13 INTERIM VOICE RESPONSE SYST    240     250       0       0                   250
 038 1 FSS        2C-02    13 ENHANCED MODEL II FSAS        2201    3169    4876    5104                 23976

   TOTAL PROGRAM                                           2451    3419    4876    5104                 24226

 120 1 TERMINAL   2 -01    14 ENHANCED TERMINAL CONFLICT    1240     170     610       0                  1180
 116 1 TERMINAL   2P-02    14 TIPS                          1870    1376     610       0                  1986
 261 1 TERMINAL   2P-02.1  14 TOWER CAB DISPLAY TECHNIQUE    127      50       0       0                    50
 122 1 TERMINAL   2P-03    14 ARTS III                      2045     700    1829       0                  2529
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REPORT DATE 03/16/82                    ECD 5 YEAR PLAN (.     TO FY-87)                         )      3

KEY J CLASS    PROJECT IR TITLE                      FY-82   FY-83   FY-84   FY-85       TOT 83-87

600 1 TERMINAL 2B-08    14 ARTS II INTERFACE W/MODE S    1010     250     122    1786            4177
317 1 TERMINAL 2B-09    14 VSCS (SEE ENROUTE)               0       0       0       0               0
024 1 GROUND A 2D-01    14 TERMINAL RADAR (ASR) PROGRA      0       0       0       0               0
137 1 GROUND A 2D-02.5  14 MODE S SCAN                      0       0       0     783            1196

TOTAL PROGRAM                                        6142    2946    3171    2169           11118


006 1 FSS      2C-03    15 CENTER WEATHER PROCESSOR      1320    3561    7040   10591           50531
039 1 FSS      2C-04    15 AWOS                           328     216       0       0             216
299 0 FSS      2C-04.1  15 IMPROVED WX & VISIBILITY SE    300      50     610     638            1835
032 1 FSS      2C-05    15 JAWS                           530     239     219       0             458
083 1 FSS      2C-08    15 WIND SHEAR DETECTION             0       0     853    2552            5474
355 0 FSS      2C-09    15 ADVANCED WEATHER DEVICES/SE      0       0       0       0            4137
005 1 GROUND A 2D-03    15 WEATHER RADAR (NEXRAD)        2323    3975    4632    4338           20251
210 0 GROUND A 2D-03.1  15 TERMINAL WEATHER RADAR           0       0    1829    1531            5255
317 0 ROTOCRAF 9 -09    15 HELI WX DETECTION-FORCAST      100      27     244     255            1068

TOTAL PROGRAM                                        4901    8068   15427   19905           89175


263 0 AIRBORNE 5 -10    16 HUMAN FACTORS SAFETY ANALYS   1019    1171     414     408            3130
217 0 ASSO DEV 7 -05    16 ADVANCED TECHNOLOGY            650    1331    1829    2552           14576
347 0 ASSO DEV 7 -11    16 ADVANCED CONTROL CONCEPTS T     25    1031    1219    1276            8968

TOTAL PROGRAM                                        1694    3533    3462    4236           26674


325 0 SAFETY   4 -01    18 IMPACT DAMAGE SENSITIVITY        0     100       0       0             100
326 0 SAFETY   4 -02    18 COMPOSITE MATERIALS TEXT         0      60      98       0             158
328 0 SAFETY   4 -03    18 ADHESIVE BOND STRENGTH           0      50      61      64             175
330 0 SAFETY   4 -04    18 COMPOSITE MATERIAL FATIGUE       0     100     244     255            1141
337 0 SAFETY   4 -05    18 TIRE PAINT & PRESSURE SYS      140       0       0       0               0
338 0 SAFETY   4 -06    18 TIRE WATER SPRAY SUPPRESSIO      0      40     158     191             389
339 0 SAFETY   4 -07    18 WHEEL BRAKE PERF REQTS.          0      90     195       0             285
250 0 SAFETY   4 -08    18 PROPULSION SAFETY-TRANSPORT    210     670    1463    1021            5596
188 0 SAFETY   4 -09    18 PROPULSION SAFETY - GEN AVI    160      40     219     485            1773
340 0 SAFETY   4 -10    18 FAILURE EFFECTS ANALYSIS        40     380     468     868            3769
342 0 SAFETY   4 -11    18 FLIGHT CHAR. OF NEW DESIGNS     25     170     427    1021            4671
173 0 SAFETY   4 -12    18 AVIONICS ENG                    60     280     488     574            2697
191 0 SAFETY   4 -13    18 ICING CERTIFICATION STDS       260     840    1950    1531            6896
186 0 SAFETY   4 -15    18 STRUCTURAL CRASHWORTHINESS     230    1340    1365    1621            6744
184 0 SAFETY   4 -16    18 CABIN INTERIOR CRASHWORTHIN    120     200     731     510            3071
179 0 SAFETY   4 -17    18 EMERGENCY EVACUATION SYSTEM    150     200     366     434            2166
343 0 SAFETY   4 -18    18 FUEL SYSTEM CRASHWORTHINESS     15     210     341     421            1754
187 0 SAFETY   4 -19    18 FUEL SAFETY - TRANSPORT        840    3050    1650     523            6642
331 0 SAFETY   4 -20    18 CABIN MATERIAL FIRE TEST ME    800    1780    2438    2553            8815
160 0 SAFETY   4 -21    18 TRANSPORT FIRE MGT & SUPPR     290     440     902     689            3439
178 0 SAFETY   4 -22    18 MATERIAL FIRE RES IMPROVEME    340     440     536     561            3506
177 0 SAFETY   4 -23    18 GENERAL AVIATION FIRE SAFET    240     420     414       0             834
254 0 SAFETY   4 -25    18 MODULAR AUTO X-RAY SYSTEM      310     720     890     931            3401
257 0 SAFETY   4 -26    18 NUCLEAR MAG RESONANCE EXPLO    270     460     670     600            2565
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RE S CLASS	PROJECT	PR	TITLE	-82	FY-83	FY-84	FY-85	TOT 83-87
258 0 SAFETY	4 -27	18	VAPOR DET OF EXPLOSIVES	100	160	637	467	2062
259 0 SAFETY	4 -28	18	SABOTAGE PREVENTION	50	120	622	791	3144
256 0 SAFETY	4 -29	18	THERMAL NEUTRON ACTIV EXPLO	20	80	110	51	335
260 0 SAFETY	4 -30	18	OPERATIONAL TST OF SECURITY	20	70	244	255	1395
255 0 SAFETY	4 -31	18	ADVANCED X-RAY TECHNOLOGY	90	160	207	217	1492
265 0 AIRBORNE	5 -11	18	AIRCRAFT CERTIFICATION	210	140	246	204	1443
151 0 ROTOCRAF	9 -06	18	AIRWORTHINESS-ROTOCRAFT	510	190	376	383	2298
152 0 ROTOCRAF	9 -07	18	* ROTO ICING PROTECTION TEC	260	350	152	255	1195
320 0 ROTOCRAF	9 -08	18	* ROTO STRUCTURAL CRASHWORT	25	210	756	983	3012
652 0 (DEDUCT)	(NONE)	18	* #152 FUNDS IN #151	260-	350-	152-	255-	1195-
820 0 (DEDUCT)	(NONE)	18	* #320 FUNDS IN #188	25-	210-	756-	983-	3012-
TOTAL PROGRAM.				5500	13000	16366	17201	82560
349 0 MEDICINE	8 -01	19	MEDICAL STANDARDS & PROCEDR	415	415	1036	855	3005
350 0 MEDICINE	8 -02	19	DET OF PERSONNEL SELECTION	1115	1052	1361	891	4910
278 0 MEDICINE	8 -03	19	CABIN SAFETY EMERGENCY PROC	83	83	101	106	514
279 0 MEDICINE	8 -04	19	ESCAPE & FLOTATION DEVICES	340	100	98	102	516
269 0 MEDICINE	8 -05	19	INVEST OF MAT TO IMPROVE SA	340	340	518	351	1696
268 0 MEDICINE	8 -06	19	HUMAN PERFORMANCE-AIRMAN &	350	350	945	893	3405
293 0 MEDICINE	8 -07	19	EFFECTS OF DRUGS & TOXIC AG	220	220	512	467	1992
292 0 MEDICINE	8 -08	19	BIOMEDICAL & PATHOLOGIC INVE	500	500	610	576	3452
TOTAL PROGRAM				3173	3060	5161	4721	19490
294 0 ENVIRONM	6 -01	20	AIRCRAFT SOURCE NOISE ABATE	400	500	731	893	4290
295 0 ENVIRONM	6 -02	20	AIRPORT NOISE & LAND-USE CO	700	700	853	768	3678
296 0 ENVIRONM	6 -03	20	AIRCRAFT ENGINE EMISSIONS C	500	400	366	383	1962
297 0 ENVIRONM	6 -04	20	FAA ENVIRONMENTAL PROTECTIO	400	400	488	510	2482
156 0 ROTOCRAF	9 -10	20	* HELI NOISE REDUCTION	50	175	152	128	588
656 0 (DEDUCT)	(NONE)	20	* #156 FUNDS IN #295	50-	175-	152-	128-	588-
TOTAL PROGRAM				2000	2000	2438	2552	12408
063 0 AIRBORNE	5 -09	21	SIMULATION SUPPORT	125	47	792	829	3438
316 0 ASSO DEV	7 -03	21	SYS ANAL & INTEG (2 OF 2)	1265	1601	853	893	5282
307 0 ASSO DEV	7 -04	21	ATC SIMULATION FACILITY	384	1271	2316	2424	11156
133 0 ASSO DEV	7 -08	21	DEVELOPMENT OF COMMON STAND	0	0	610	538	1913
354 0 ASSO DEV	7 -10	21	IN SERVICE ENGINEER (R&D)	0	0	4876	5104	20812
054 0 ROTOCRAF	9 -01	21	HELI TERM INSTRUMENT PROCED	302	170	122	128	420
TOTAL PROGRAM				2166	3095	9569	10016	42981
004 1 ENROUTE	2A-04	23	MODERN COMPUTER WITH HOST	3240	16800	44420	24576	101744
007 1 ENROUTE	2A-05	23	SECTOR SUITE & SOFTWARE	8000	30200	112271	109966	368702
121 1 TERMINAL	2B-05	23	TERMINAL COMPUTER ENHANCEMT	0	0	0	0	0
TOTAL PROGRAM				11240	47000	156641	134542	470446

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REPORT DATE 03/16/82          FED 5 YEAR PLAN (FY-83 TO FY-87)                              PAGE
E S CLASS    PROJECT NO TITLE                    82   FY-83   FY-84   FY-85  FY-86-87  TOT 83-87

                   GRAND TOTAL                 83302  133500  285984  269002  408186    1096672
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March 16, 1982

Facilities and Equipment
Five Year Plan
FY 1983-1987
(Dollars in Millions)

February 26, 1982

Pricing: The following Five Year Plan for the Facilities and Equipment program reflects programs identified in the NAS Plan of December 1981. To convert to current dollars, the following inflation rates were applied:

FY 84	5.1%
FY 85	4.7%
FY 86	4.1%
FY 87	3.7%

Key: Parenthetical entries following program titles, e.g., (GA VI-58), are intended as a cross-reference to the NAS Plan (Program-Page), which is not in budget sequence. The following program designators are used:

ER	En Route Systems
TS	Terminal Systems
FS	Flight Service Systems
GA	Ground-to-Air Systems
IC	Interfacility Communications Systems
AS	Auxiliary Systems
XX	Indicates program not included in the published NAS Plan, but required to support the National Airspace System.

Summary of Five Year Plan

FY 1983	FY 1984	FY 1985	FY 1986/1987	Grand Total FY 1983-1987
$725.0	$1,393.0	$1,407.0	$2,541.0	$6,066.0

Facilities and Equipment
Five Year Plan
FY 1983-1987
(Dollars in Millions)

	FY 1983	FY 1984	FY 1985
1. Air Route Traffic Control Facilities			
a. Long Range Radar			
Long Range Radar Program (GA VI-90)	-	$ 73.1	$ 40.9
Weather Radar Program (GA VI-92)	-	-	9.0
RML Trunking (IC VII-42)	$ 7.0	1.2	
RML System Replace/Expansion/Netting (IC VII-50)	-	48.8	51.1
b. Automation Equipment			
EnRoute Automation Hardware Improvements and Enhancements (ER III-26)	.6	1.7	
Provide Conflict Alert and Minimum Safe Altitude Warning for EARTS (ER III-38)		3.4	
Oceanic Display and Probe System (ODAPS) (ER III-40)	15.0		
Improve and Retrofit Direct Access Radar Channel (DARC) (DARC Enhancements) (ER III-42)	25.0		

	FY 1983	FY 1984	FY 1985
b. Automation Equipment (continued)			
Modernize ATC Computer with Host (ER III-46)	$ 4.6	$ 247.5	$ -
Sector Suite and Software Redesign (ER III-48)			402.0
Automated EnRoute Air Traffic Control (AERA) (ER III-50)			
Integrated Flow Management (National Flow) Enhancement of Central Flow Control (ER III-52)			
c. Other Center Facilities			
Replace Tone Equipment (ER III-54)	29.2	26.7	9.9
Communications Facilities Consolidation (GA VI-60)	3.0	44.9	52.4
Voice Switching and Control System (VSCS) (ER III-56)			
Central Flow Control (ER III-30)	8.0	4.9	.7
Center Building Expansion and Plant Modernization (ER III-58)	2.0	5.9	52.1
Integration of Non-Radar Approach Control into ARTCC's (ER III-60)		5.9	

	FY 1983	FY 1984	FY 1985
c. Other Center Facilities (continued)			
Air Route Traffic Control Center Consolidation (ER III-62)	$ 6.0	2.4	4.1
Data and Voice Multiplexing (IC VII-40)	3.9		
Telecommunications Data Base Replacement and Relocation (IC VII-44)		.6	.7
National Airspace Data Interchange Network (NADIN IA) (IC VII-46)	6.0		
National Airspace Data Interchange Network (NADIN) Enhancements (IC VII-48)		5.0	18.8
Satellite Trunking (Integrated Voice/Data) (IC VII-56)			
En Route Sub-total	$ 110.3	$472.0	$641.7

	FY 1983	FY 1984	FY 1985
2. Airport Traffic Control Facilities			
a. Terminal Area Radar			
Terminal Radar (ASR) Program (GA VI-86)		$ 87.1	$112.8
Mode-S/Data Link (GA VI-84)	$ 40.0	106.2	76.6
Replace Beacon Antennas (XX)	8.0		
Airport Surface Detection Equipment (ASDE-3) Radar (GA VI-88)	34.0	42.7	
b. Terminal Area Automation			
ARTS IIIA Memory (TS IV-24)	4.5	4.9	
Replace BRITEs with PPIs (XX)	3.6		
Provide Enhanced Terminal Conflict Alert (TS IV-28)	.4		
Provide Multi-Sensor DAS Input Switch for Individual ARTS III Displays (TS IV-30)		5.2	
Replace Flight Data Entry and Printout Devices (ER III-28)	6.5		

	FY 1983	FY 1984	FY 1985
2. Airport Traffic Control Facilities			
b. Terminal Area Automation (continued)			
ARTS-to-ARTS Interface (TS IV-34)		$ .6	
Airport Capacity Improvement/Delay Reduction Operational Testing Program (TS IV-44)			$ 2.1
Replace TPX-42 Systems and TRACON BRITE Displays (TS IV-46)	$ 37.1		
ARTS IIA Enhancements (TS IV-48)	12.9		
Integrated Flow Management (Terminal Flow) (TS IV-52)			
Provide Power Conditioning Systems for Automated Radar Terminal Systems III (ARTS III) (TS IV-66)		28.2	

2. Airport Traffic Control Facilities

c. Other Terminal Facilities:

	FY 1983	FY 1984	FY 1985
Integrated Communication Switching System (ICSS) (TS IV-56)		$ 18.3	$ 19.2
Air Ground (A/G) Communications Replacement (GA VI-58)	$ 14.9		
Voice Switching and Control System (VSCS) (TS IV-60)			
ATCT/TRACON Relocate, Modernize and Takeover (TS IV-62)	45.1	68.9	35.8
Bright Radar Indicator Tower Equipment (BRITE) (TS IV-64)		9.8	5.1
VFR Tower Closures (TS IV-68)	.5		
Terminal Hub Consolidation (TS IV-70)		82.9	63.8
Terminal-to-Center Integration (TS IV-72)			
Hub Consolidation Multiplexing (IC VII-52)			
Provide Remote Maintenance Monitoring (AS VIII-28)	15.1	25.0	40.9
Packet Radio (IC VII-54)			2.6
Terminal Sub-total	$ 222.6	$479.8	$358.9

	FY 1983	FY 1984	FY 1985
3. Flight Service Facilities			
a. Flight Service Stations:			
Establish Flight Service Automation System (FS V-24)	$ 74.3	$ 61.6	$ 57.7
Establish Enhanced Model 2 FSAS (FS V-26)		9.6	7.6
Expand Capacity and Consolidate Flight Service Data Processing System (FSDPS) (TS V-28)			.6
Replace NATCOM (XX)	12.8		
Center Weather Processor (FS V-30)		25.6	11.5
Automated Weather Observing Systems (AWOS) (FS V-36)	2.3	24.3	23.4
Hazardous Inflight Weather Advisory Service (HIWAS) (XX)	.5	3.5	

	FY 1983	FY 1984 *	FY 1985
3. Flight Service Facilities			
a. Flight Service Stations: (continued)			
Direction Finder (DF) Modernization (GA VI-82)	$ -	$ 46.4	$ 10.0
Teletype Replacement (FS V-50)	15.1	7.7	5.3
Air Ground (A/G) Communications Equipment Replacement (GA VI-58)	-	33.3	14.2
Replace Tone Equipment (FS V-52)	7.0	7.3	7.1
Integrated Communication Switching System (ICSS) for Flight Service Stations (FS V-54)	-		8.7
Flight Services Sub-total	$112.0	$219.3	$146.1

	FY 1983	FY 1984	FY 1
4. Air Navigation Facilities			
a. VORTAC			
VORTAC (GA VI-62)	$ 19.6	$ 13.0	$ 9.0
b. Low and Medium Frequency Facilities			
Non-Directional Beacon (NDB) (GA VI-64)	.9	3.7	6.4
c. Instrument and Visual Landing Systems			
Replace Tube-Type ILS (GA VI-68)	29.8		
Establish Microwave Landing System MLS)/Precision Distance Measuring Equipment (PDME)/Service Test and Evaluation Program (STEP) (GA VI-72)	19.7	26.8	84.3
RVR - Establish/Upgrade (GA VI-74)	-	6.3	3.2
Establish Visual/Electronic NAVAIDS (GA VI-76)	13.7	14.7	12.5
o NPA Program	(3.6)		
o VASI	(3.9)		
o TCH Program	(1.6)		
o Add MALSR	(4.0)		
o Establish REIL	(.6)		
Approach Lighting System Improvements (ALSIP) (GA VI-78)	15.5	20.5	21.5
Retrofit MALSR Threshold Lights (GA VI-80)	2.1	4.3	4.5
Low Level Wind Shear Alert System (FS V-42)	7.8		
Landing/NAVAIDS Sub-total	$109.1	$ 89.3	$141.4

	FY 1983	FY 1984	FY 1985
5. Housing, Utilities, and Miscellaneous Facilities			
b. Utilities and Miscellaneous			
Regional Projects (Includes Land and TTY Relocate) (XX)	$ 34.9	$ 46.6	$ 48.6
In-Service Engineering (XX)	9.4	10.3	10.8
Mechanized Material Handling System (XX)	3.8	2.9	1.6
Aviation Safety Analysis System (XX)	3.3		
Computer Based Instruction (CBI) (AS VIII-30)	1.7	1.7	
Occupational Safety and Health Requirements (XX)	2.0	2.0	.4
Establish the National Emergency Radio Communication System (AS VIII-32)	1.8	5.3	5.1
Modernize and Improve Unmanned FAA Airway Facilities Buildings and Equipment (AS VIII-34)	5.0	14.7	17.9
Modernize Airport Cables into Loop System (AS VIII-36)			6.4
Miscellaneous Sub-total	$ 61.9	$ 83.5	$ 90.8
6. Aircraft and Related Equipment			
Aircraft Fleet Conversion/Flight Inspection Modernization (AS VIII-26)	82.9	24.4	15.4
Procure/Replace Aircraft and Avionics Equipment (F,E&D) (AS VIII-26)	3.5		
Aircraft Sub-total	$ 86.4	$ 24.4	$ 15.4

	FY 1983	FY 1984	FY 1985	FY 1986/1987
7. Development, Test and Evaluation Facilities (XX)	$ 22.7	$ 24.7	$ 12.7	$2,541.0
TOTAL, All Activities	$725.0	$1,393.0	$1,407.0	$2,541.0
GRAND TOTAL FY 1983-1987		$6,066.0		

AVIATION TRUST FUND BUDGET FORMULATION

(Current Dollars)
$ Millions

	1982	1983	1984	1985	1983-1987 Program/Revenue Totals
BEG. UNCOMMITTED BALANCE	3021.0	1118.8	806.0	123.4	
REVENUE FROM TAXES	279.8	2660.9	3020.0	3426.1	17247
TRUST FUND:AIRPORT PROGRAM	450.0	450.0	450.0	450.0	2250
FACIL & EQUIP	261.0	725.0	1393.0	1407.0	6066
RESEARCH & DEV.	72.0	134.0	286.0	269.0	1097
OPERATIONS	1800.0	2015.0	1917.0	1959.0	9997
TOTAL AUTHORIZATION	2583.0	3324.0	4046.0	4085.0	19410
SUB-TOTAL	717.8	455.6	-219.9	-535.5	
INTEREST	400.9	350.4	343.3	257.8	1341
END UNCOMMITTED BALANCE	1118.8	806.0	123.4	-277.7	297

Tax Assumptions

Ticket = 8% all years
Waybill = 5% all years
Fuel:
Av. Gas.= 12¢/gal. Tax increases 2¢/gal. per year thru the period beginning in FY-1984
Av. Jet.= 14¢/gal. Tax increases 2¢/gal. per year thru the period beginning in FY-1984
Int'l Dep.= $3/enplanement all years
Tire&Tube = 5¢ & 10¢/lb. respectively

Other Assumptions

Operations expenses from the Trust Fund in FY-82 = $1.8 billion , FY-83 = 2.015 billion
Operations expenses from the Trust Fund in all other years is consistent with coverage of 85% of FAA's total annual budget